RUMINANTS IN THE HIGHLANDS OF NORTHERN THAILAND.

AN AGROSOCIOLOGICAL STUDY.

by L. FALVEY.

THAI-AUSTRALIAN HIGHLAND AGRONOMY PROJECT,
CHIANG MAI UNIVERSITY, THAILAND.

AUSTRALIAN DEVELOPMENT ASSISTANCE BUREAU, P.O. BOX 887 CANBERRA 2601
and TRIBAL RESEARCH CENTRE, DEPARTMENT OF PUBLIC WELFARE, THAILAND.

With love to mum

Joan

Lindsay

ACKNOWLEDGEMENTS

The content and preparation of this manuscript represents the assistance of many people.

Primary acknowledgement should be given to those persons who assisted in data collection; Ajan Choke Mikled, lecturer of the Department of Animal Science, Faculty of Agriculture, Chiang Mai University; Khun Egachai Thanyalappitak, Livestock Specialist of the Tribal Research Centre, Department of Public Welfare; and more recently Khun Prakob Hengmichai, Livestock Specialist, also from the Tribal Research Centre. Without the keen interest shown by these specialists and their willingness to perservere under sometimes unpleasant conditions this data could not have been collected. I take this opportunity to express my gratitude to them.

The assistance of the project supervisor Dr. Ross Humphreys, my project collegues Mr. Peter Hoare and Dr. Alan Andrews as well as that of Dr. John McKinnon of the Tribal Research Centre and Mr. Trevor Gibson of the United Nations Program for Drug Abuse in criticising the manuscript, I also gratefully acknowledge.

L. Falvey

August 1977

CONTENTS

SUMMARY 1

PREFACE 5

INTRODUCTION 7

METHODS 14

OWNERSHIP OF CATTLE AND BUFFALO 21

ATTITUDES OF DIFFERENT ETHNIC GROUPS 37

- Khon muang
- Karen
- Meo
- Lahu
- Yao
- Lisu
- Akha
- Yunnanese Haw

SACRIFICIAL USE OF LIVESTOCK 47

MANAGEMENT OF CATTLE AND BUFFALO 51

PROBLEMS OF THE HIGHLAND RUMINANT INDUSTRIES 63

- Disease
- Theft
- Predators
- Other Problems

ECONOMIC ASPECTS OF THE HIGHLAND CATTLE AND BUFFALO INDUSTRIES 69

- Sales and Purchases
- Income derived from Agistment
- Income from Leasing of Working Stock
- Pack Animals
- The Relative Efficiency of Cattle and Buffalo

BIOLOGICAL PERFORMANCE OF HIGHLAND CATTLE AND BUFFALO INDUSTRIES 84

- Cattle
- Buffalo

MOVEMENT OF LIVESTOCK INTO NORTHERN THAILAND 98

INTEGRATION OF RUMINANT AND AGRICULTURAL SYSTEMS 104

OTHER RUMINANTS OF THE HIGHLANDS 111

THE FUTURE FOR RUMINANTS IN THE HIGHLANDS 116

REFERENCES 120

TABLES

1. Mean Rainfall and Maximum and Minimum Temperatures from four years' data (1972 to 1976) at Pa Kia. 10

2. List of villages surveyed, their ethnic composition, altitude, size and main source of income. 16

3. Cattle and Buffalo populations, Ownership and Distribution of ownership in individual villages, presented in Ethnic Groupings. 24

4. Distribution of Cattle Ownership by household per village. 31

5. Distribution of Buffalo Ownership by household per village. 32

6. Distribution of Cattle and Buffalo Ownership by household per village. 33

7. Details of Deaths and Associated Sacrifices in Old Pa Kia. 49

8. The Herd Structures of Cattle and Buffalo in some villages surveyed. 59

9. Biological data for cattle. Ranges and means from information obtained in surveys. 71

10. Biological data for buffalo. Ranges and means from information obtained in surveys. 81

11. Average Price per kilogram received for Highland Cattle in Villages in different years. 88

12. Prices per kilogram received for Buffalo in different years. 88

13. Buffalo leasing details. 94

FIGURES

1. Map of Thailand showing the main physiographic regions. 9
2. Activity diagram for rearing ruminants in the highlands. 13
3. Location of villages included in surveys. 18
4. Mean cattle and buffalo population per village by ethnic group. 26
5. Mean percent of households tending cattle or buffalo per village by ethnic group. 28
6. Mean percent of cattle or buffalo herd tended by the largest stock holder per village by ethnic group. 30
7. Mean distribution of cattle ownership by household. 34
8. Mean distribution of buffalo ownership by household. 35
9. Mean distribution of cattle and buffalo by household. 36
10. Mean herd distribution by sex and catagory for highland cattle. 60
11. Mean herd distribution by sex and catagory for buffalo. 60
12. Estimated herd distribution of cattle by age in highland villages. 61
13. Estimated herd distribution of buffalo by age in the highlands. 62
14. Rainfall distribution, seasonal and reproductive patterns of highland cattle at Pa Kia. 72
15. The relationship between age and weight for highland cows. 73
16. The relationship between girth circumference and weight of highland cows. 75
17. Liveweight changes of highland cattle grazing native pasture over a one year period. 76
18. Schematic representation of natural pasture quality and quantity over one year. 77
19. Rainfall distribution, seasonal and reproductive patterns of buffaloes in the highlands. 82
20. Variations in the price of cattle and buffalo over several years. 90
21. Routes by which cattle and buffalo enter Thailand and the more common routes of travel in Thailand. 103
22. The approximate growth curve for goats in the highlands. 113

SUMMARY

An agrosociological study was undertaken in the highlands of north Thailand to determine the biological, economic and sociological systems as they applied to ruminant livestock. A total of 42 villages and 1180 households were surveyed over a period of 15 months following a routine questionairre. Questions asked were grouped into five main sections; definition of the status of the village, ownership and attitudes, biological information, socioeconomic data, and attitudes toward improvements.

Ownership of cattle and buffalo varied with ethnic group of the villages surveyed, the Lisu tribe showed the highest average village cattle population while the Karen and Akha tribe had the average highest village buffalo populations. The distribution of ownership was greatest within villages of the Karen tribe, while the proportion of the herd owned by the largest stock owner was greatest in Meo villages. The most common number of cattle or buffalo owned by one household was two head. The reasons for raising cattle or buffalo were found to vary between ethnic groups; for example, the sacrificial role of cattle in the Meo culture and buffalo in the Akha culture overide any intentions to raise livestock for profit.

Management of livestock was determined to be minimal. No additional feed except salt was ever offered to cattle or buffalo and medical treatment was not commonly practised. Care in tending stock was not consistent between villages and the incidence of problems related to theft or predators varied with this input. No weaning was found to be practised and breeding management, where practised tended to be misguided, ineffective and cruel. Bull to breeder ratios for both cattle and buffalo were below 1:5.

The main problems of the present industry were determined to be theft, disease, predators, feed quality and instability of native pastures.

Biological data for cattle and buffalo were collected and the figures are compared with estimates calculated by alternative means. A predicted liveweight curve for highland cows was calculated which indicated a maximum liveweight of less than 250 kg at about six years of age.

Income was realized from cattle and buffalo by means of sale, agistment, leasing and using for pack purposes. A comparison of the relative biological and economic efficiencies of cattle and buffalo indicated that buffalo can produce both a faster increase in biomass as well as a higher income.

The movement of cattle into Thailand in response to a better market is described and areas of greatest activity indicated.

The integration of livestock industries including small ruminants with other agricultural industries is introduced and strategies for the development of ruminant livestock industries in the highlands discussed.

บทย่อ

การศึกษาทางด้านสังคมวิทยา เกี่ยวกับการ เกษตรบนที่สูงทางภาค เหนือของไทย ได้จัดให้มีขึ้น เพื่อที่จะได้ตัดสินทั้งในด้าน ชีววิทยา, เศรษฐกิจ และสังคมวิทยา ที่จะนำมาใช้กับการ เลี้ยงสัตว์ เคี้ยว เอื้อง ในการสำรวจใช้แบบสอบถามทั่ว ๆ ไป เหมือนกันทุกหมู่บ้าน ใช้ เวลาในการสำรวจ ๑๕ เดือน ใช้ตัวอย่างในการสำรวจ ๔๒ หมู่บ้าน จำนวน ๑๑๘๐ หลังคา เรือน (ครอบครัว) ในการสอบถามจะแบ่งออก เป็น ๕ ตอน คือ ลักษณะของหมู่บ้าน ทัศนคติ เกี่ยวกับสัตว์ เลี้ยงและการ เป็น เจ้าของ ความรู้ทางด้านชีววิทยา ข้อมูลทางด้านเศรษฐกิจและสังคม และทัศนคติ เกี่ยวกับการปรับปรุงพันธุ์สัตว์

การ เป็น เจ้าของวัวและควายในหมู่บ้านชาว เขา เผ่าต่าง ๆ แตกต่างกัน โดย เฉลี่ยชาว เขา เผ่าลีซอมีจำนวนวัวในหมู่บ้านมากที่สุดขณะ เดียวกันชาว เขา เผ่ากะ เหรี่ยงและอีก้อมีจำนวนควายในหมู่บ้านมากที่สุด การ เป็น เจ้าของสัตว์ เลี้ยงจะกระจายมากที่สุดในหมู่บ้านของชาว เขา เผ่ากะ เหรี่ยง ขณะ เดียวกันการ เป็น เจ้าของสัตว์จำนวนมาก เป็นฝูงใหญ่จะมีมากที่สุดในหมู่ชาว เขา เผ่าแม้ว โดยทั่ว ๆ ไปแล้วชาว เขาจะมีจำนวนวัวหรือควาย เพียง ๒ ตัวต่อครอบครัว เหตุผลของการ เลี้ยงวัว หรือควายของชาว เขาแตกต่างกันแล้วแต่ เผ่า เช่น ชาว เขา เผ่าแม้วมีประ เพณีการฆ่าวัว เพื่อ เซ่นผี หรือชาว เขา เผ่าอีก้อมีประ เพณีการฆ่าควาย เพื่อ เซ่นผี ซึ่งพวก เขาไม่ได้ตั้งใจหรือมีความกระตือรือร้นที่จะ เลี้ยงสัตว์ เพื่อผลกำไร

การจัดการ เกี่ยวกับสัตว์ เลี้ยงของชาว เขานั้น ทำกันแบบง่าย ๆ ไม่มีการให้อาหาร เสริม เลยนอกจาก เกลือที่จะให้วัวหรือควาย การให้การรักษาโดยใช้ยาแทบจะไม่รู้จักกัน การปล่อยสัตว์ เลี้ยงขาดการดูแล เอาใจใส่อย่าง-จริงจัง เป็นช่องทางให้ เกิดปัญหาติดตามมาได้แก่ ขโมย การถูกล่าโดย เสือปัญหานี้จะแก้ไขได้โดย เอาใจใส่ดูแล สำหรับด้านการผสมพันธุ์ก็ขาดการจัดการที่ดี ไม่มีการแยกลูกออกจากแม่ ซึ่งถ้าหากมีใครทำพวก เขาก็จะ เห็นว่า ทำในทางที่ผิด ไม่มีประโยชน์และทารุณโหดร้าย อัตราส่วนของจำนวนพ่อพันธุ์ต่อจำนวนสัตว์ตัว เมียทั้งวัวและควาย มีอัตราส่วนต่ำกว่า ๑:๕

ปัญหาใหญ่ของอุตสาหกรรมการผลิตสัตว์บนที่สูง พอจะประมวลได้ว่า เกิดจาก ขโมย, โรค, เสือ คุณภาพของอาหารและไม่มีทุ่งหญ้าธรรมชาติที่อุดมสมบูรณ์ตลอดปี

ข้อมูลทางด้านชีววิทยาของวัวและควายซึ่งได้รวบรวมเอาไว้ ได้นำมาประเมินโดยอาศัยค่าเฉลี่ยที่ศึกษาจากที่ต่างกัน ปรากฏว่าค่าทำนายน้ำหนักตัวโดยการคำนวณนี้ระบุว่าวัวตัวเมียมีน้ำหนักตัวสูงสุดน้อยกว่า ๒๕๐ กิโลกรัม เมื่ออายุราว ๖ ปี

รายได้จากสัตว์เลี้ยงคือวัวและควายนี้สามารถได้มาจากการขาย, การรับจ้างเลี้ยง, การให้เช่า และการใช้บรรทุกต่างของ จากการเปรียบเทียบประสิทธิภาพของวัวและควายทั้งด้านชีววิทยา และเศรษฐกิจ บ่งชี้ว่าควายสามารถเพิ่มน้ำหนักได้เร็วกว่า ซึ่งอาจทำรายได้ให้มากกว่า

การลักลอบนำวัวเข้ามาภายในประเทศมีอยู่ในหลายท้องที่ ตามความต้องการของตลาด

การพัฒนาอุตสาหกรรมปศุสัตว์โดยเลี้ยงแกะกับแพะ ร่วมกับการเกษตรแขนงอื่นได้มีการริเริ่มและในรายงานนี้ก็ได้อภิปรายปัญหาอุปสรรค ที่มีต่อการพัฒนาการเลี้ยงปศุสัตว์ในที่สูง

PREFACE

The following research was conducted as part of the livestock programme of the Thai Australian Highland Agronomy Project, Faculty of Agriculture, Chiang Mai University. The Highland Agronomy Project originated from a request from the Royal Thai Government to the Australian Government for assistance in determining means of utilizing the large grassland areas created by slash and burn cultivation in the highlands in northern Thailand. The research conducted by the Highland Agronomy Project includes improved pastures and crops as well as improved techniques in ruminant production. Research work of the project is conducted in association with the counterpart agency Chiang Mai University and agricultural development work in association with the counterpart agency Department of Public Welfare.

There has been a considerable amount of research conducted in the highlands by various organizations, much of which has been sociological. While this information is most useful to agencies interested in development, it was considered necessary that more detailed information about existing ruminant production systems in the highlands be obtained to guide both the direction of future research and the implementation of current findings. This monograph collates information gained from detailed surveys in the fields of biology, economics and sociology relevant to ruminant livestock in the highlands. Such an approach was considered to minimize the sociological effects of changing a traditional system as well as identifying points in the system where problems exist and improvements could be made. Thus the study reported determines a base line for improvements in the highland ruminant industry.

The Highland Agronomy Project aims to assist hilltribes fulfil their aspirations in the field of agricultural development. The diverse cultures of this area and lack of previous work has made the highlands a prime target for many projects. Wongsprasert (1977) presented a general justification for research the highlands North Thailand viz "The government feels itself threatened by highland minorities who: destroy watersheds by shifting cultivation, cultivate poppy and transport opium into Thailand from Burma, migrate illegally from neighbouring countries, ignore Thai laws, share cultures which are radically different from Thai culture, and have a relatively high population growth rate. In the past misunderstanding between some agencies of the Thai government has led to conflicts between Thai and hill

people". While such justification may be valid, the aim of assisting highland people to raise their standard of living within the Thai society is considered sufficient in itself.

Improvement of the livestock industry in developing countries is usually based on intensive "backyard" production. In the highlands of north Thailand, however, large underutilized areas of grassland are available. Development of the livestock industry could increase the income earning capacity of highland people as well as increasing the protein content of their diet which is most probably below the level recommended and which includes, for example in the case of the Lahu people, wild animals such as bears, monkeys and reptiles (Wongsprasert, 1977), which are decreasing in numbers in the highlands.

The following study was designed to detemine such factors as: ownership patterns, attitudes toward livestock as well as production and economic factors so that improvements in the industry could be attempted. The alternative approach of replacing the existing system rather than improving it was not considered to be relevant to the welfare of the highland people.

INTRODUCTION

INTRODUCTION

The highlands of north Thailand are generally considered to be that area of land in the eight provinces of Chiang Rai, Lampang, Lamphun, Phrae, Chiang Mai, Nan, Tak and Mae Hong Sorn, where the gradient varies appreciably from the lowland plain. The highlands comprise an estimated 75% of the 105,000 sq.km. in these eight provinces (Figure 1). Within the northern region valleys of altitudes 250-600 m occupy 50% of the area while lands between 600-1200 m and above 1200 m occupy 39 and 11% respectively.

The highlands are composed of north-south granite ridges with areas of limestone outcrops and small areas of schists, sandstones and shales. Soils are mainly red-yellow podzolics with some areas of red brown earths occuring between limestone crags.

The climate of these areas is monsoonal with three distinct seasons: a wet season from May to October, a cool dry season from November to mid-February, and a hot a dry season from mid-February to April. Rainfall varies over the highlands but is usually greater than 2000 mm per year (Gibson, 1976). Some climatic data from Pa Kia (altitude 1500 m), the research site of the Highland Agronomy Project are presented in Table 1. Highest rainfall occurs during the period May to October, the highest maximum temperatures during April to March, and the lowest minimum temperature during December to January.

The predominant agricultural activity in the highlands is shifting cultivation whereby areas of forest or savannah are cleared, burned and cropped. These swiddens are abandoned as soil fertility declines or weed invasion increases markedly. These swiddens do not revert to the original climax vegetation which was a closed ever-green forest on most soils above 1000 m.

The inhabitants of the highlands have traditionally been called "hilltribes" a term which includes the ethnic groups, Karen, Meo, Lahu, Yao, Lisu and Akha. Pecularities of the individual ethnic groups relevant to this study are discussed in the text. Keen (1972) has noted that the highlands are also becoming more densely populated by Khon Muang people who are forced out of the lowland regions by overcrowding and associated factors. The population of the highlands is cons-

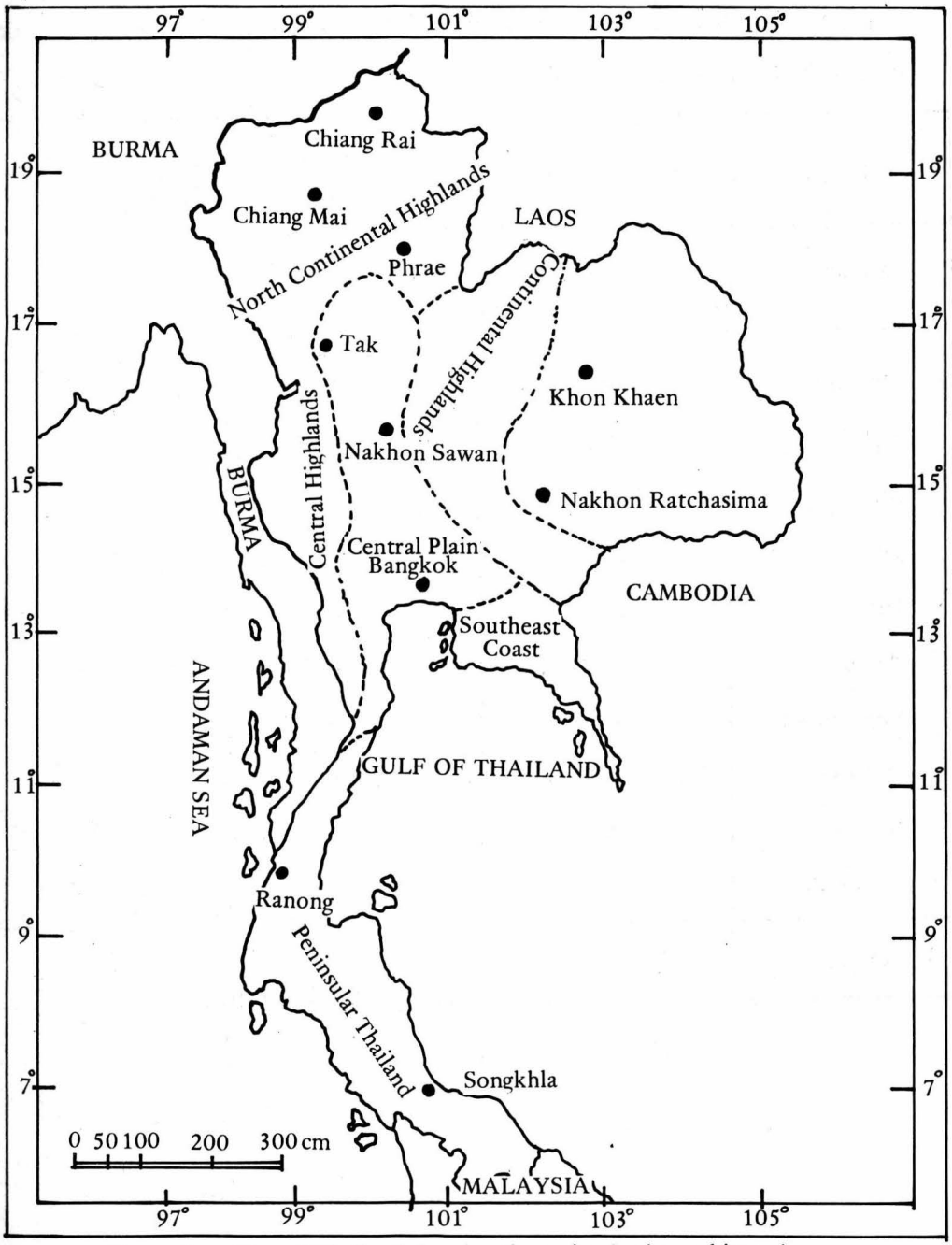


Figure 1 Map of Thailand showing the main physiographic regions.

Table 1 Mean Rainfall and Maximum and Minimum Temperatures from four years data (1972 to 1976) at Pa Kia.

Month	Rainfall (mm)	Maximum Temperature (^{o}C)	Minimum Temperature (^{o}C)
January	37	24.2	10.3
February	0	28.2	12.3
March	14	31.3	15.6
April	24	32.0	17.3
May	243	26.7	16.7
June	245	25.1	16.9
July	207	24.9	16.5
August	382	24.5	16.4
September	359	25.4	16.6
October	251	26.2	16.0
November	64	23.1	13.5
December	3	27.4	10.8
YEAR	1829	26.6	14.9

tantly being further increased by immigration of the various ethnic minorities from bordering countries.

The whole area of the highlands of north Thailand is classified as forest reserve which theoretically outlaws tree felling, burning and cultivation. Residents of the highlands employ their own systems of tenure, which although not recognized by the law are strictly adhered to within the community. One dominant feature of land holding despite variations in customs between and within tribes is the right of any one family to cultivate all the unoccupied land that they are capable of using for as long a period as they so desire. Sometimes the abandoned swiddens are used only by people from the same village or the same ethnic group but in other instances the swiddens of different ethnic groups merge in the same general area (Keen, 1972).

Villages move frequently as the soil becomes exhausted in one vicinity, but nowadays, the vacant unused tracts of land that once were easily found no longer exist except for areas with poor soils, e.g., between Mueng Khong and Doi Sam Muen. The problem of land shortage is beginning to be recognized by the highland residents but there is at present little overall evidence of changes in agricultural systems or in attitudes toward land. Karen people, who usually settle in the lower altitudes of the highlands have evolved a rotational system that permits them to stay in the one area and are therefore an exception.

Swiddens are cut under three different systems. The first, an opium based forest fallow, is one in which virgin or mature secondary forest is felled early in the year and the plot double-cropped to maize and opium for as many years as possible. The second, a subsistence based bush follow, employs a one year cultivation and ten or less years forest regrowth rotation. The third system is opportunistic supplementary shifting cultivation, which is practised by lowland people forced to clear swiddens in the highlands and does not involve planned rotational fallowing or control of fires. This classification of highland people based on cropping techniques is most useful for discussions related to the environment, although apparently less applicable in some to anthropological studies.

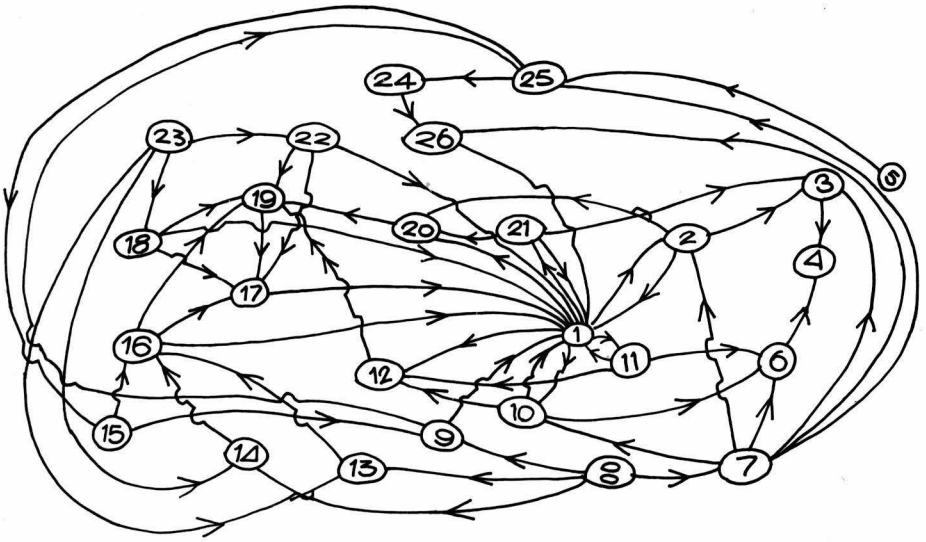
The short fallow periods, or more particulary successive years of cropping, which are common to all systems of cultivation except tha of the Karen, do not allow the reestablishment of the original forest cover before the land is cropped again, and savannah grasses tend to dominate. This invasion is encouraged by the wild fires escaping from the preparation of new swiddens. The dominant grass species under this system is Imperata cylindrica (Ya Kha (หญ้าคา) cogon grass,alang-

alang, kunai grass or blady grass), which is the main native pasture species supporting the existing ruminant industries in the highlands.

Cattle have probably been raised in the highlands of Thailand as long as the area has been populated. The breeding of the highland cattle, which have developed into a breed that differs physically from lowland cattle, is obscure but is most probably Bos guarus x B. sundiacus statified with B. indicus. Sex dimorphism is pronounced; the bulls have a well developed hump while cows do not. Ears are short and do not droop, muzzle and eyes may be pink or black and a gold coat colour predominates (Falvey, 1977). Lowland cattle brought up to highland areas experience difficulty in walking on the steep slopes due to their inexperience and longer legs. This lack of adaptation can lead to rapid weight losses in lowland cattle brought into highland regions.

Buffalo have entered highland areas more recently than cattle as some highland dwellers have constructed or bought paddy fields, or as lowlanders find they cannot raise sufficient numbers of buffaloes themselves. Goats are kept by some villagers and sheep have been introduced by some organizations working in the highlands. Attempts to model the economic systems operational in the highlands have produced the activity diagram present as figure 2 (Davies and Toewiwat, 1976) which describes the various factors acting in the production system for highland ruminants.

The following study reports the aspects of ownership of ruminants, attitudes of their owners, management methods, problems associated with keeping these animals, biological and economic information for the ruminant species: cattle, buffalo, goats and sheep, in the highlands of northern Thailand.



Key : 1. Village weight of ruminants.
2. Weight of males sold.
3. Male contribution to income.
4. Contribution to income of ruminants.
5. Capital from previous seasons activities.
6. Female contribution to income.
7. Current local prices of stock.
8. Location of village.
9. Losses through theft etc.
10. Weight of males sold.
11. Weight of females consumed.
12. Number of active females.
13. Quality of grazing.
14. Quantity of grazing.
15. Labour used for herding.
16. Village TDN available.
17. Weight of young.
18. External parasites of stock.
19. Village reproductive rate.
20. Number of active males.
21. Weight of males consumed.
22. Internal parasites in stock.
23. Weather.
24. Captial expended on ith ruminant.
25. Attitude of villagers to ruminants.
26. Weight of stock bought.

Figure 2 Activity diagram for rearing ruminants in the highlands (after Davies and Toewiwat, 1976)

METHODS

METHODS

The information in this report has been gained largely from questionnaire-type surveys of villages of each major ethnic group represented in the highlands in many geographical localities. The names of the villages included in the study, the dominant ethnic group of the village, the altitude, amphoe (district), the size of the village in terms of number of households, and the primary source of income are presented in Table 2. A location map of Thailand is presented as Figure 2 and the location of villages by numbers from Table 2 is shown on Figure 3. A total number of 1180 households in 42 villages made up the survey sample.

The villages that made up this sample were chosen from four catagories; (i) villages close to the research site of the Thai Australian Highland Agronomy Project, (ii) some villages in the Mae Sa catchment area where a United Nation Development Programme (Mae Sa Integrated Watershed Development Project) is being conducted, (iii) villages associated with the United Nations Programme for Drug Abuse Control and, (iv) other miscellaneous villages over wide areas of the highlands. Villages in the first grouping were chosen to follow up contacts already established while those in the second and third groupings were chosen as villages likely to be interested in development of ruminant industries. The last grouping comprised villages of ethnic groups not represented adequately or typically in the previous three groupings.

Wherever possible, the owners or tenders of ruminant livestock were gathered together in a group to answer the survey questions. Such meetings were organized through the village headman or local Thai extension worker or village teacher. Meetings invariably were in the evening to avoid disruption of daily routines and to enable greater attendance.

Table 2 List of villages surveyed, their ethnic composition, altitude, size and main source of income.

Number	Village (Thai Name)	Ethnic (group)	Altitude (m)	Amphoe	Number of households	Main Source of income
1	Ton Kham	Khon Muang	500	Mae Taeng	26	wet rice
2	Mae Ta Man	Khon Muang	360	Mae Taeng	131	wet rice
3	Thung La Khon	Khon Muang	400	Mae Taeng		
4	Pang Mae Ta Man Nok	Khon Muang	680	Mae Taeng	10	miang
5	Pang Mae Ta Man Nai	Khon Muang	800	Mae Taeng	11	miang
6	Phapujom	Meo	930	Mae Taeng	23	opium
7	Huai Tad	Lahu	900	Mae Taeng	31	agricultural products
8	Mae Mae	Lahu	1,300	Chiang Dao	10	opium
9	Mae Kok I + II	Meo	1,350	Chiang Dao	3	opium
10	New Pa Kia	Meo	1,500	Chiang Dao	12	opium & potatoes
11	Old Pa Kia	Meo	1,320	Chiang Dao	29	opium & potatoes
12	Mae Pun Luang	Lahu	1,325	Viang Pa Pao	43	opium
13	Pha Duea (Lao Si)	Yao	600	Mae Chan	45	corn and sesame
14	Doi Yao	Yao	500	Chiang Rai	32	corn and sesame
15	Pha Mi	Akha	600	Mae Sai	72	opium
16	Yang Ha	Karen	1,060	Samoeng	30	rice
17	Pang Kia	Karen	1,100	Samoeng	17	rice
18	Pang Klung	Karen	1,000	Samoeng	6	rice
19	Mae Chang	Karen	800	Mae Sariang	30	rice
20	Sam Muen	Lisu	1,350	Chiang Dao	64	opium
21	Mae Tho	Meo	1,100	Hod	24	opium
22	Boa Lek	Meo	1,200	Hod	22	opium

Table 2 List of villages surveyed, their ethnic composition, altitude, size and main source of income.

Number	Village (Thai Name)	Ethnic (group)	Altitude (m)	Amphoe	Number of households	Main Source of income
23	Lao Lee	Meo	1,150	Hod	13	opium
24	Lie Doi	Meo	1,200	Hod	3	opium
25	Mae To Luang	Karen	1,050	Hod	30	rice
26	Khun Wang	Meo	1,320	San Pa Thong	20	opium
27	Pui Pu Lee	Meo	1,300	Mae Chaem	12	opium
28	Huai Hin Fon	Meo	1,250	Mae Chaem	13	opium
29	Pui (key village)	Meo	1,400	Mae Chaem	27	opium
30	Pui (Karen)	Karen	1,200	Mae Chaem	22	rice
31	Pong Khrai	Khon Muang	1,000	Mae Rim	27	miang
32	Pang Luang	Khon Muang	1,160	Mae Rim	20	miang
33	Buak Jam	Meo	1,280	Mae Rim	35	opium
34	Nong Hoi	Meo	1,300	Mae Rim	47	opium
35	Na Law	Lisu	8-900	Chiang Dao	58	opium
36	Khob Dong	Lahu	1450	Fang	24	opium
37	Saen Jai Mai	Akha	680	Mae Chan	33	rice
38	Law Sii Kuay	Yao	620	Mae Chan	24	rice
39	Ja Phuu	Lahu	660	Mae Chan	23	rice
40	Saen Sok	Akha	580	Mae Chan	34	rice
41	Huey Kang Plaa	Yao	560	Mae Chan	19	rice
42	La Pa Ta	Lisu	900	Mae Taeng	25	opium

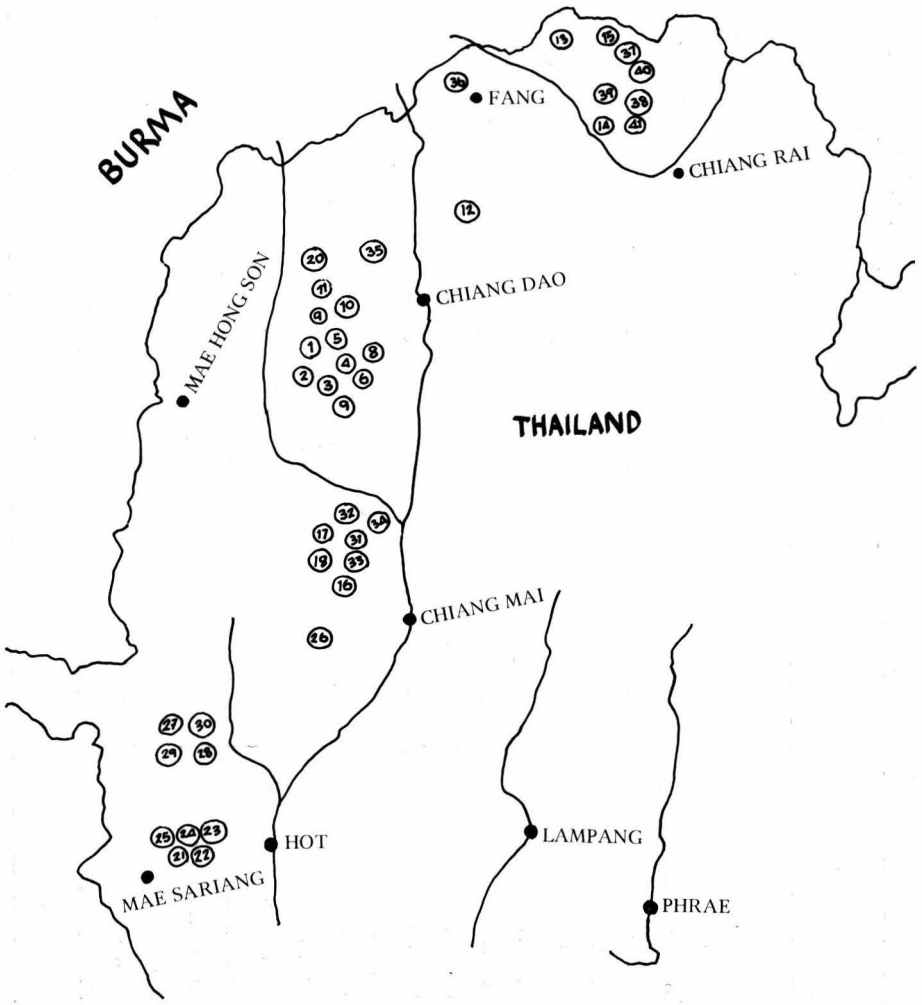


Figure 3. Location of villages included in surveys (numbers refer to villages designated in Table 2)

In some cases such coordination was not possible and thus it was necessary to approach individual households. Interviews were conducted in Thai or northern-Thai, after the purpose of the surveys had been explained and the villagers were reassured of the disinterested nature of the questions. The details of ownership and of sales, purchases and deaths of stock in individual households were determined first and then an open discussion among these persons was designed to determine management methods, attitudes toward livestock and some biological information. Interviews lasted for two to three hours per village under good conditions but in cases where individual households were visited, up to two days were necessary to obtain the required information. The day time was used to investigate cattle, their management, productivity and grazing management, The time of the year when interviews were conducted affected attendance and at some busy periods of the agricultural calendar, when villagers where living in their field huts away from the village, the village had to be revisited to obtain a complete survey.

Survey forms were of two types, one used with the headman of each village contacted and one for use with each household that tended some ruminants. Within each survey form sections of similar questions were arranged as follows.

General subject of questions	Substance of questions
Preliminary Information	Ethnic group, Map location, Size of village, Educational facilities, Means of access.
Ownership and Attitudes	Number of stock owned by sex, Source of stock, Reasons for ownership, Length of time of stock raising, Feeding techniques, Medical treatment, Stock tending, Future of stock raising.
Biological Information	Age at first calving, Calving intervals, Bull/cow ratio, Age at maturity by sex, Calving season, Deaths, Castration, Abortions, Length of heat, Mothering ability, Feed availability.
Socioeconomic Data	Purchases, Sales, Reasons for transactions, Means of transfer, Stock killed locally, Age of stock disposed of, Profits, Traders, Stock thefts, Losses to predators.

Attitudes toward Improvements	Importance of stock raising, Expected potential income, Changes in management methods.

At the close of each interview the interviewer recorded his own personal assessment of the interest in stock shown by the farmers. Individual questions related to production information for each of the species, cattle, buffalo, sheep and goats were asked.

Obtaining reliable quantitative information was difficult, thus checking and repetitive questions were employed to improve the accuracy of the final data. The highland people contacted in these surveys kept no records and many of the questions asked may have been difficult for them to answer if they had not previously thought in the same terms as the questions. Keen (1972) had previously recorded this difficulty; he noted that when seeking "explanations for the actions of people who live in traditional societies, ... it is possible for different individuals of the same group to account for their actions in varied and contradictory terms". The original reasons for a particular activity that has now become an accepted practice may be long forgotten and the people do not feel the need to justify their action.

The results are presented on an overall basis and specific differences between ethnic groups or other factors are mentioned in the text; these are amplified in the chapter concerning attitudes toward livestock where each ethnic group is discussed separately.

In villages where more than one ethnic group was present in a village (usually Chinese Haw residing in villages where opium was produced) the village was listed under the majority ethnic group because factors relevant to the ruminants in the village were usually fairly uniform within a village. This approach is consistent with established practice.

Background information on individual villages, apart from that relevant to this study, is not included in this text. Detailed sociological information has already been obtained and published by the Tribal Research Centre, Chiang Mai, and is available to the general reader.

OWNERSHIP OF CATTLE AND BUFFALO

OWNERSHIP OF CATTLE AND BUFFALO

Highlanders were found to have become cattle or buffalo tenders either by buying stock, by tending stock on agistment, by receiving stock as a gift or by inheritance. Purchase of cattle represents a large investment for a highland dweller whose annual income may be of the same order as the cost of one beast (Hoare et al., 1977). In one instance recorded, a resident of the Meo village, Ban New Pa Kia sold potatoes to the value of 4000 ฿ which he then used to buy cattle. Normally, in such a circumstance, the money would come from the sale of opium which is still the largest income producing crop for the highlands. Cattle or buffalo tended on agistment earn income in the form of every second calf becoming the property of the tender, thereby allowing the tender of the stock to become a stock owner himself. Wedding presents of cattle from a father to his new son-in-law were recorded in one Lisu village, Ban Doi Sam Muen. Inheritance of livestock was commonly the principal means by which villages become cattle owners, particularly in the more stable villages.

Cattle and buffalo were found to be raised by highland dwellers for various reasons. The most common reason was as a means of insurance against hard times. For example, at the Lisu village, Ban Na Law, villagers were not prepared to sell cattle unless the price was well above the prices being paid in the vicinity for similar transactions or unless they had encountered a hard year and had found it necessary to supplement their income by the sale of some livestock. Cattle sales were similar to withdrawing money from a bank. Large ruminants may also be tended for draft purposes, in the case of cattle for transportation of miang and possibly other crops, and in the case of buffalo for cultivation of paddy rields usually at other locations of lower elevation. In some cases cattle and buffalo are viewed as a means of producing regular income but this is usually only encountered in villages that have had prolonged contact with lowland civilization. The animistic beliefs of some ethnic groups require the sacrifice of varying numbers of large ruminants upon death of certain persons. Sacrificial usage of cattle and buffalo is discussed later in this text. Slaughter of cattle or buffalo in a village solely for meat consumption is rare. It is usually restricted to very special days in only some villages or to animals that have broken a leg or received some other incapaciting injury.

The cattle and buffalo populations, and factors related to the distribution of ownership within each village are presented in Table 3. Correlation coefficients between cattle and buffalo ownership and the consumer to worker ratio per household (that is, the number of persons to be provided for in a household relative to the number of persons capable of producing) were usually low. In general values were higher for cattle than buffalo but all values were low and of no real significance. This lack of correlation does not necessarily indicate that cattle are not a sign of affluence, neither does it indicate that the consumer to worker ratio is not useful as an indicator of the potential income of a household. The relationship in many cases was confounded because cattle and buffalo were divided among children on the death of parents and thus the stock ownership of the family would not be function of the consumer to worker ratio of that family. In some cases cattle have been donated by organizations promoting highland development which further reduces the relationship between stock ownership and the consumer to worker ratio since stock are usually given to persons who do not already own cattle. Buffalo ownership tends to be more evenly distributed than that of cattle, possibly because buffalo are often owned specifically for cultivation purposes, especially among the Karen people. Thus one would expect a relationship between buffalo ownership and ownership of paddy lands. Irwin (pers. comm.) has in fact observed such a trend in land allocation studies in the Mae Sa catchment region of the highlands.

The headman of a village is often the largest stock owner within the village. It is in fact often possible to determine the headmans' residence by the quantity of cattle dung around the house. One notable exception to this general rule was encountered in the Lisu village, Ban Na Law, where the headman owned only one beast out of a total village herd of more than 200 head. This man had probably chosen an alternative means of investing his savings. The status of the headman in Lisu and Karen villages is not as prestigeous or sought after as amongst other groups (McKinnon, pers. comm.).

The mean populations of cattle and buffalo per village on an ethnic group basis are presented in Figure 4. From the villages involved in the survey cattle populations were the highest in Lisu villages followed not very closely by Meo and then Lahu villages. The greater cattle populations encountered in Lisu villages is indicative of the attitude of the Lisu toward cattle who view them primarily as a reserve to be drawn on in time of need. The lowest average cattle population per village was for

Table 3 Cattle and Buffalo populations, Ownership and Distribution of ownership in individual villages, presented in Ethnic Groupings (including stock on agistment)

Village name and ethnic group.	Cattle population	Number of households owning cattle	Buffalo population	Number of households owningcattle	Percent of households owningcattle or buffalo	Percent of the cattle and buffalo herd owned by the largest owner
Khon muang						
Ton Kham	28	11	29	10	54	19
Mae Ta Mae & Tung La Khon	67	3	-	-	45	9
Pang Mae Ta Man Nok	20	3	-	-	30	40
Pang Mae Ta Man Nai	34	4	-	-	36	41
Pong Khrai	27	4	24	13	56	27
Pong Lung	28	7	-	-	35	29
Karen						
Yang Ha	50	11	131	22	73	9
Pang Kluay	13	1	41	5	83	55
Mae Chaem	38	8	45	13	57	19
Mae To Luang	41	5	155	25	87	14
Pui (Karen)	103	12	43	10	64	19
Meo						
Phapu Jom	31	12	1	1	48	26
Mae Kok I	22	3	-	-	100	55
Old Pa Kia	53	10	-	-	38	28
New Pa Kia	14	5	6	2	50	35
Mae To	142	15	10	2	75	23
Boa Lek	62	13	4	1	59	24
Lao Lee	113	11	18	3	85	31
Lei Doi	12	3	-	-	100	58
Khun Wang	119	11	11	3	60	28
Pui Pu Lee	79	6	-	-	50	70
Huai Hin Fon	161	9	2	1	69	37
Pui (Key Village)	145	19	12	3	44	21
Buak Jam	19	3	2	1	9	52
Nong Hoi	141	23	37	11	57	11

Table 3 Ownership details (Continued)

Village name and ethnic group	Cattle population	Number of households owning cattle	Buffalo population	Number of households owning buffalo	Percent of households owning cattle or buffalo	Percent of the cattle and buffalo herd owned by the largest owner
Lahu						
Huai Tat	21	5	-	-	16	24
Mae Mae	55	4	-	-	44	49
Mae Pun Luang	165	28	61	16	65	14
Khob Dong	62	7	6	1	29	31
Ja Phuu	-	-	44	20	87	9
Yao						
Pha Deua (Lao Si)	34	2	64	19	42	29
Doi Yao	-	-	31	11	34	19
Law Sii Kuay	-	-	18	8	33	22
Huay Kang Plaa	12	2	2	1	11	57
Lisu						
Doi Sam Muen	225	31	15	4	48	9
Na Law	200	14	0	0	24	25
La Pa Ta	200+	5	0	0	20	40
Akha						
Pha Mai	48	1	200	30	42	36
Sae Jai Mai	41	8	-	-	24	29
Saen Suk	-	-	58	9	27	26

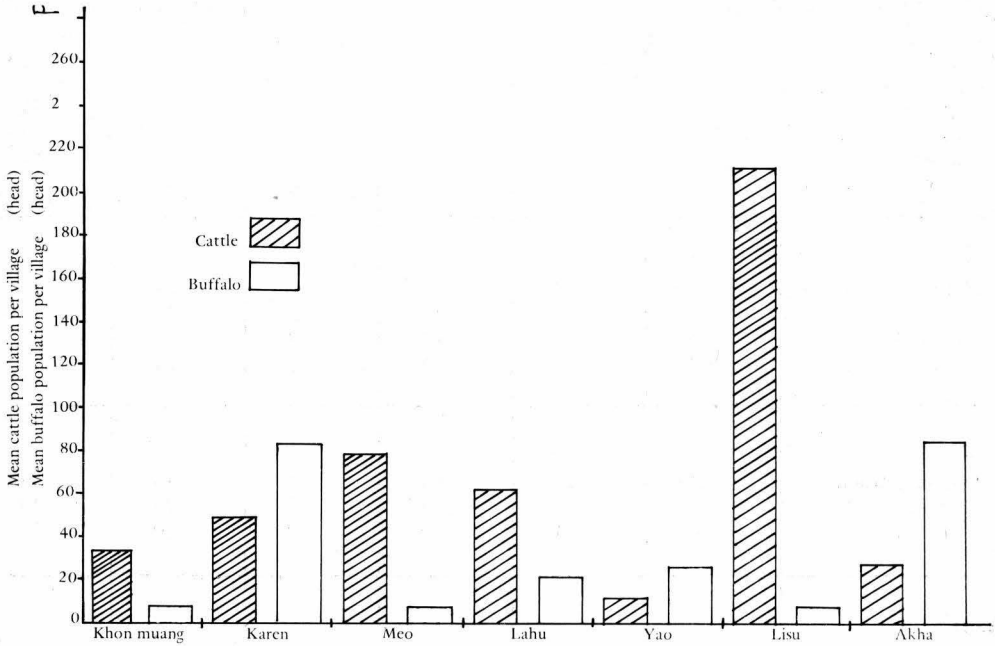


Figure 4. Mean cattle and buffalo population per village by ethnic group.

Ethnic group

Yao villages and this figure may reflect the changing station of the Yao as they strive, usually successfully, to enter the lowland economy where the possibilities of raising large numbers of cattle are restricted. The low populations of cattle encountered in Akha villages is possibly a function of their relative poverty in some cases and the working of paddy fields where buffaloes are preferred, in others. The figure of the next lowest group, Khon muang, may reflect different social attitudes that lead to investment in the form of housing and other materials instead of livestock. Within the Khon muang group there are, however, two distinct groups, the miang producers who usually own cattle and the wet rice farmers who usually own buffalo.

Mean buffalo populations were highest in Akha villages, followed by Karen, Yao and then Lahu. This order of ethnic groups approximates the order of paddy field cultivation among these ethnic groups although in the case of the Akha tribe, some tending of buffalo for leasing to lowland areas for paddy field cultivation increased the mean population for this group. The other three ethnic groups; Khon muang, Meo and Lisu had similar buffalo population figures. The Khon muang resident in the highlands and included in this survey were involved in miang production and some paddy cultivation while neither the Meo nor the Lisu had any appreciable involvement in wet rice cultivation.

The mean percentage of households tending cattle or buffalo per village (Figure 5) was highest for the Karen ethnic group where paddy field cultivation is of importance to most households. Stock, primarily buffalo in the case of the Karen (refer to figure 4) are owned primarily for cultivation of these paddy fields, not as a cash reserve. Thus ownership tends to be more evenly distributed. The concentration of ownership of large livestock in Akha, Yao and Lisu villages most probably reflects a greater concentration of wealth within these villages than within villages of the other ethnic groups especially Karen. The relatively wide dispersion of cattle and buffalo tending in Meo villages (60% of households tended cattle or buffalo) varies from comments by other observers because in many instances donations of cattle or buffalo by agencies promoting highland development have been made to the Meo ethnic group.

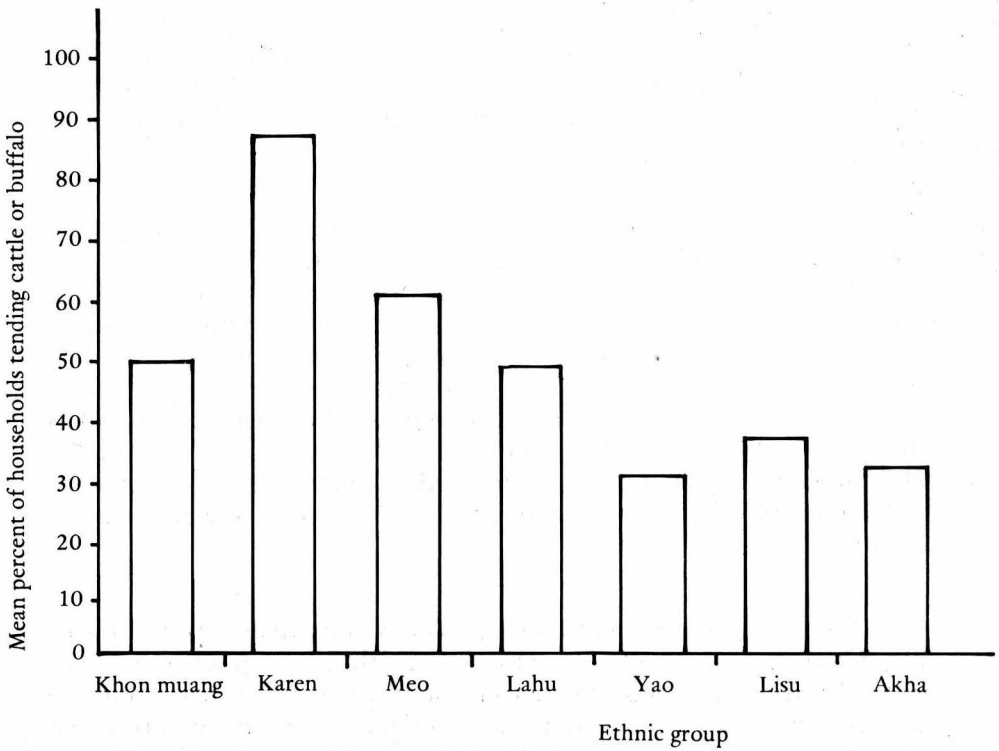


Figure 5. Mean percent of households tending cattle or buffalo per village by ethnic group.

Another means of investigating the distribution of cattle or buffalo ownership is to express ownership as percent of the herd tended by the largest stock holder (Figure 6). On this basis, the range of results is surprising low (about 11%). Lower concentrations of ownership per household are often encountered in Lisu villages where the large stock populations (Figure 4) are spread fairly evenly throughout the village. The distribution of cattle ownership of around 30% of the village herd being owned by one household indicates the disparity of wealth usually encountered within highland villages which is commonly oriented towards the headman and other influential persons in a village.

The distribution of ownership for cattle, buffalo, and cattle plus buffalo for each village surveyed is presented in Tables 4, 5 and 6. Grouping on an ethnic group basis does not reveal any large differences between the groups and, for the most part, individual villages seem to follow the same tread. Most households have cattle or buffalo populations of less than five head. The mean distribution of ownership by household as calculated from all the data in Table 4, 5 and 6 is presented as Figures 7, 8 and 9 which indicate that the most common herd size for a household is two head of cattle or buffalo. There is general downward trend in these graphs as would be expected and deviation from the average curve could probably be reduced with a larger sample size. In fact, the degree of variation in Figure 9 derived from a large sample is probably less than that of Figures 7 and 8. Two head of large ruminants per household was more common than one head, possibly because, two head of either cattle or buffalo are required if the animals are kept for draft purposes. In villages where stock are not used for draft, the two head may be a cow and calf, older progeny having been sold or disposed of in other ways so that usually the household has one or two head.

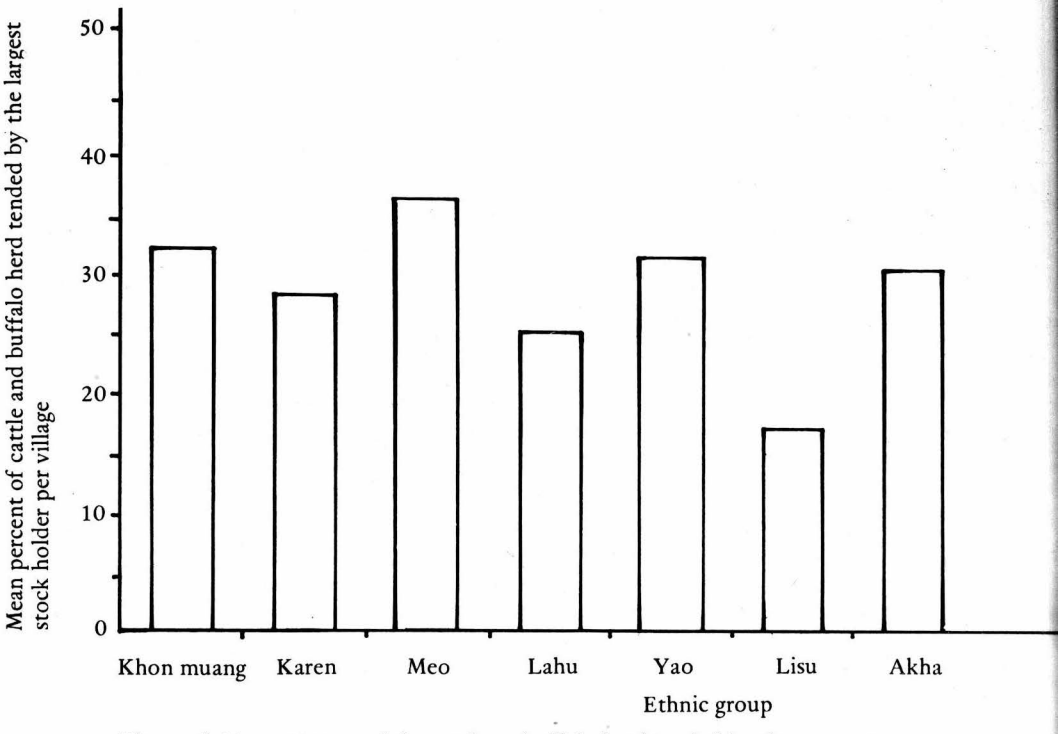


Figure 6. Mean percent of the cattle or buffalo herd tended by the largest stock holder per village by ethnic group.

Table 4 Distribution of Cattle Ownership by household per village

Ethnic Croup	Village Name	Number of Cattle																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16-19	20-24	25-29	30-39	> 40
Khon Muang	Pong Khrai	1	1	1			6		8			1									
	Pang Lung			2		2	1	1	1												
	Mae Ta Man Nok				1				2												
	Mae Ta Man Nai			1		1							1		1						
	Ton Kham	1	2	3	3		1	1													
	Mae Ta Man	1	8	1	1		1				1			1	1						
	Thung La Korn																				
	Mean	0.2	1.8	1.3	0.8	0.2	1.5	0.3	1.7	–	0.2	0.2	0.2	0.2	0.3						
Karen	Pui		1	3	1	1		1	1				1				2	1			
	Mae To Luang			1			1		1	1						1					
	Mae Chang		3	3					1			1									
	Pang Kluay												1			1					
	Yang Ha		1	2	2				3		1										
	Pang Kia		2		1																
	Mean	–	1.2	1.5	0.7	0.2	0.2	0.2	1.0	0.2	0.2	0.2	0.3	–	–	0.3	0.3	0.2			
Meo	Buak Jan				1		1			1											
	Nong Hoi	4	3	2	2		3		1	3	4		2								
	New Pa Kia	2		1	1	1															
	Old Pa Kia	2	2	1	1	1			1				1			1					
	Mae Kok (I+II)			1				1					1								
	Pha Pujom	4	4	1	1	1		1													
	Pui (A+B)	2	2	1	3	3	2	1			1					1		2	1		
	Huai Hin Fon			1			3		1		1		1								2
	Mae To			4	2		3	2	1		1			1	1		1	1		1	
	Boa Lek	3	1	1	1	2	2	1		1			1								
	Lao Lee	2	2		1	2								1		1				2	
	Lei Doi		2	1				1													
	Khun Wang		3	2		2		1	1		1					1		1		1	
	Mean	1.5	1.5	1.2	1.0	0.9	1.1	0.6	0.4	0.4	0.6	–	0.5	0.2	0.1	0.3	0.1	0.3	0.1	0.3	0.2
Lahu	Khob Dong			1	1	1						1	1	1	1						
	Mae Luang	4	6	1	1	6	1	2	3		1				1	1			1		
	Huai Tat			1	2	2															
	Mae Mae					1							2						1		
	Mean	1.0	1.5	0.8	1.0	2.5	0.3	0.5	0.8	–	0.3	0.3	0.8	0.3	0.5	0.3			0.5		
Yao	Pha Deua												1					1			
	Huay Kang Plaa						2														
	Mean						1.0						0.5					0.5			
Lisu	Doi Sam Muen	5	5	2		2	1	2	2	1	1	1	2	1			3		2		
Akha	Saen Jai Mai		2	2	1	1					1		1								

Table 5 Distribution of Buffalo Ownership by household per village

Ethnic Croup	Village Name	Number of Buffalo																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16-19	〉20
Khon Muang	Pong Khai	6	5			2												
	Ton Kham	4		2	2	1	1											
	Mae Ta Man	5	16	11.	2	4	4				1				1			
	Thung La Korn																	
	Mean	5.0	7.0	4.3	1.3	2.3	1.6				0.3				0.3			
Karen	Pui	3		2	2	1				1			1					
	Mae To Luang	1	4	4	2	4	1	2		2	1		1	1		1	1	
	Mae Chang	1	5	2	1	1	2	1										
	Pang Kluay					1	3										1	
	Yang Ha					3	1	3	1			1				1		
	Pang Kia	2					1		1									
	Mean	1.2	1.5	1.3	0.8	1.6	1.3	1.0	0.3	0.5	0.2	0.2	0.3	0.2		0.3	0.3	
Meo	Buak Jan		1															
	Nong Hoi	3	1	3		2	1	1										
	New Pa Kia			2														
	Pha Pujom	1																
	Pui (A+B)		2															
	Huai Hin Fon		1															
	Mae To					2												
	Boa Lek				1													
	Lao Lee				2						1							
	Khun Wang	1	1						1									
	Mean	0.5	0.6	0.5	0.3	0.4	0.1	0.1	0.2	–	0.1							
Lahu	Khob Dong						1											
	Mae Pun Luang	5	2		1	4	2		2									
	Ja Phuu		18		2													
	Mean	1.7	6.7		1.0	1.3	1.0		0.7									
Yao	Pha Deua	2	6	5	2	1	2				1							
	Doi Yaow	1	4	4	1		1											
	Law Sii Kuay	3	2	1	2													
	Huay Kang Pha		1															
	Mean	1.5	3.3	2.5	1.3	0.3	0.8		0.3									
Lisu	Doi Sam Muen		1	1	1		1											
Akha	Saen Suk	1	1		1	1	1	1	1		1					1		

Table 6 Distribution of Cattle and Buffalo Ownership by household per village

Ethnic Crop	Village Name	Number of Cattle and Buffalo																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16-19	20-24	25-29	30-39	>40
Khon Muang	Pong Khrai	5	4	1		2			1	1					1						
	Pang Lung			2		2	1	1	1												
	Mae Ta Man Nok				1				2												
	Mae Ta Man Nai			1		1							1		1						
	Ton Kham	2	1	2	4		1	2				2									
	Mae Ta Man Thung La Korn	5	15	9	3	3	3	2		1	1		1	1	1	1	1				
	Mean	2.0	3.3	2.5	1.3	1.3	0.8	0.8	0.7	0.3	0.2	0.3	0.3	0.2	0.3	0.2	0.2				
Karen	Pui	1		3	2		1					1	1		1		1	2	1		
	Mae To Luang		4	4	2	4	1	3	1	2	1						2	1	1		
	Mae Chang	1	6	1	1	2	3	1	1								1				
	Pang Kluay					1	2											1		1	
	Yang Ha	1						1	2		1	1		1			4				
	Pang Kia			1		1	1				1										
	Mean	0.5	1.7	1.5	0.8	1.3	1.3	0.8	0.7	0.3	0.5	0.3	0.2	0.2	0.2		1.3	0.7	0.3	0.2	
Meo	Buak Jan				1		1					1									
	Nong Hoi	4	2	2		4	3	2	1	2	5						2				
	New Pa Kia	2		2		5		7													
	Old Pa Kia	2	2	1	1	1			1				1			1					
	Mae Kok (I+II)			1				1					1								
	Pha Puchom	4	4	1	1	1			1												
	Pui (A+B)	2	2	1	3	3	1	1	1		1					1		2		1	
	Huai Hin Fon			1			2		2		1		1								2
	Mae To			4	2		3	2	1		1			1	1			2		1	
	Boa Lek	3	1	1	1	2	2	1		1							1				
	Lao Lee	2	2		1	2								1			1				2
	Lei Dong		2	1					1												
	Khun Wang		4	2		1	1	1	1		1					1			1	1	
	Mean	1.5	1.5	1.3	0.8	1.5	1.0	1.2	0.6	0.2	0.7	0.1	0.2	0.2	0.1	0.2	0.3	0.3	0.1	0.2	0.3
Lahu	Khob Dong			1	1	1						1	1		1		1				
	Mae Pun Luang	3	4	2	1	4	1	2	1	1	2	1	1	2				2		1	
	Huai Tat			1	2	2															
	Mae Mae					1							2						1		
	Ja Phuu		18	2																	
	Mean	0.6	4.4	0.8	1.2	1.6	0.2	0.4	0.2	0.2	0.4	0.4	0.8	0.4	0.2		0.2	0.4	0.2	0.2	
Yao	Pha Deua	2	6	5	2	1	1											1	1		
	Doi Yaow	1	4	4	1		1														
	Law Sii Kuay	3	2	1	2																
	Huey Kang Pha						1	1	1												
	Mean	1.5	3.0	2.5	1.3	0.3	0.8		0.3									0.3	0.3		
Lisu	Doi Sam Muen	5	5	1		2	1	2	2	2	1	1	2	1			2	1	2		
	Mean																				
Akha	Saen Jai Mai		2	2	1	1					1		1								
	Saen Suk	1	1		1	1	1	1	1		1					1					
	Mean	0.5	1.5	1.0	1.0	1.0	0.5	0.5	0.5		1.0		0.5			0.5					

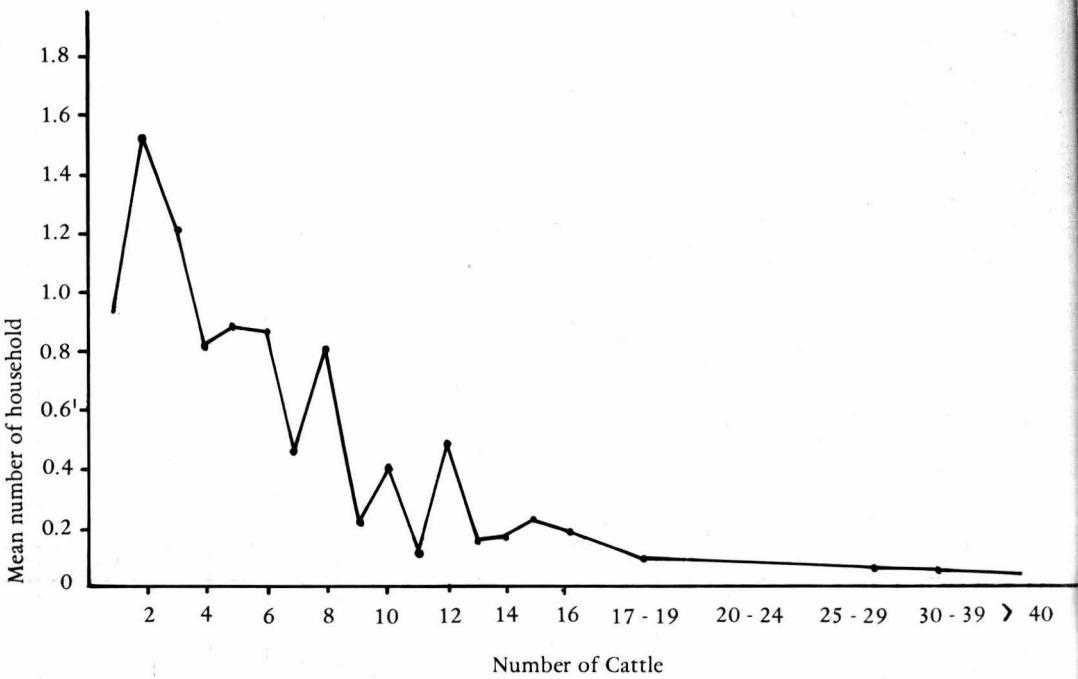


Figure 7. Mean distribution of cattle ownership by household

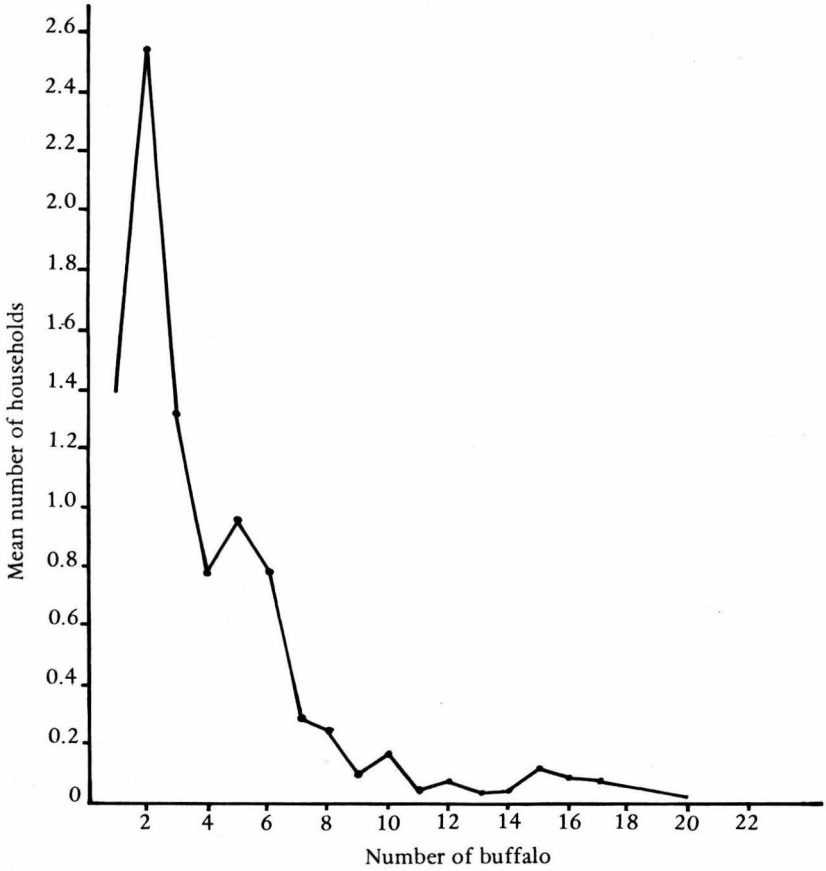


Figure 8. Mean distribution of buffalo ownership by household.

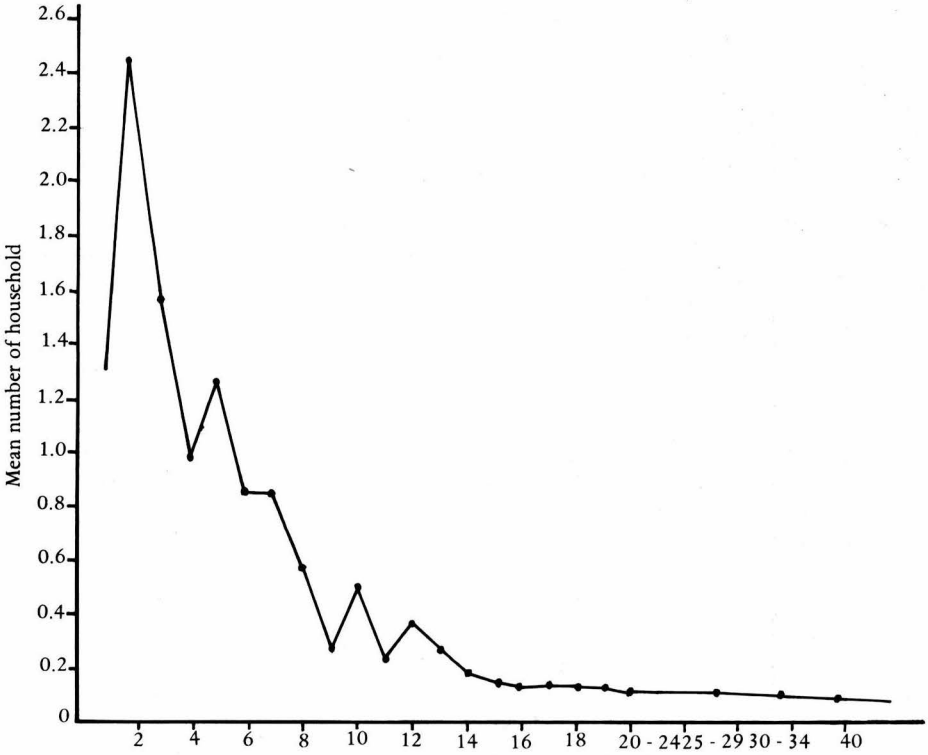


Figure 9. Mean distribution of cattle and buffalo by household.

THE ATTITUDES OF DIFFERENT ETHNIC GROUPS TOWARD STOCK

Khon Muang

Karen

Meo

Lahu

Yao

Lisu

Akha

Yunnanese Haw

THE ATTITUDES OF DIFFERENT ETHNIC GROUPS TOWARD STOCK

It has been estimated that more than 50% of the cattle raised in the highlands are sold and the remainder consumed locally (Young, 1974). Such a general estimate does not acknowledge the variations between ethnic groups, geographical location of the village and other socioeconomic factors. Wongsprasert (1977) has noted that, with regard to economics, ethnic differences are usually the greatest and that within an ethnic group, the main differences are related to geographical location. The traditions and religeous practices of different groups does have a great effect on the attitude of a group toward livestock. As Keen (1972) noted ....."In many traditional societies including those of Thailand, large domestic animals are a source of status and a bulwark against economic disaster. While life proceeds normally, the owner of cattle or other big beasts derives mainly a sense of well-being and the respect of his neighbours from them. In pure economic terms he may even lose by them. But when disaster strikes, or he needs a large sum of money he can turn his "reserve" into cash." In these surveys ethnic differences accounted for the greatest variations in attitudes towards and management of livestock, thus each ethnic group is discussed separately in the text following.

Khon Muang

The Khon muang or northern Thai people who occupy some of the lower altitudes of the highlands are probably decendants of Khmu settlers. They are involved in either the production of wet rice or miang (fermented tea). Those involved in wet rice production can be regarded for most purposes as not varying markedly from their lowland kindred. Cattle are kept primarily for draft purposes such as pulling carts for the transport of agricultural and other products for relatively short distances. Buffalo are kept to cultivate paddy fields and occasionally to pull carts. Stock graze on areas near the village and on paddy fields when they are not in use or, sometimes under crops such as tobacco. Stock are sometimes tethered for grazing and at most times are supervised casually to prevent them damaging unfenced cropping areas. Sales of stock are infrequent and when they occur it is normally because the owner has too many stock for his needs. These sales may not occur as often as may be imagined because the stock kept are predominantly male. Neither cattle nor buffalo are usually raised for the express purpose of sale.

Miang producers, although of the same ethnic group lead different lifestyles. The land where they grow their miang tea trees is usually leased from the government by an absentee landlord who can in some circumstances control marketing of the miang product to increase both his profit and his control over those producing the miang. Transport of the miang to market is by pack cattle or horses owned by some of the villages who have borrowed money, possibly from their landlord, to buy stock with the intention of improving their income.

In these villages stock owners were obviously the more wealthy families. Keen (1972) recorded the means of transport of miang along jungle paths viz 'one tang (a large bamboo basket in which the miang is packed for fermentation) is slung on each side of a beast over a pack saddle and long lines of animals are a common site on the mountain trails, carrying miang to lowland market towns". Cattle are more commonly used for transportation of miang than horses. They graze among the miang bushes on native pasture species that increase in productivity with the removal of the forest canopy by the miang farmers. As the cattle help to keep the ground clear and do not damage the miang bushes they are allowed to wander freely in the area. Miang producers may also look after the cattle of other persons who cannot raise them themselves. The fee for this agistment is usually every second calf born to the agisted cows.

Unlike the other ethnic groups of the highlands, Khon muang people do not usually regard cattle as insurance against bad times. Excess cattle are usually sold off quickly and any income not necessary for survival may be spent on improving living standards.

No superstitions concerning the markings of stock such as those mentioned by Cockrill (1974) were encountered. Preferences for coat colour and other non-production traits seemed to be of secondary interest to more useful characterities such as muscular conformation and ease of pairing for cart-pulling.

The religion of the Khon muang, the traditional Thai Buddism, means that they are reluctant to kill sick stock which, in the case of an epidemic, can assist the spread of disease to healthy animals. There are, of course, some Buddists among the other ethnic groups of the highlands who may act similarly.

Karen

The Karen people, who number about 161,900, make up 56% of the highland population, excluding Khon Muang people (Information from Tribal Research Centre (TRC), Chiang Mai). They are widely distributed throughout the western half of north Thailand usually at lower altitudes in locations that have a depression or a valley and are near a stream or spring (Walker, 1975).

Large livestock, in particular cattle, are owned by rich families who use them as means of accumulating wealth as insurance against crop failure. Buffaloes are kept to cultivate paddy fields which the Karen build in every position possible. Karen villagers said that they preferred to raise cattle and buffalo to pigs and poultry because the larger livestock can look after themselves. Very few cattle and buffalo are slaughtered for local use because of the high value placed on livestock. In most Karen villages the desire to have good investments such as large livestock and silver can be so great that people will live very simply making personal sacrifices in order to accumulate wealth.

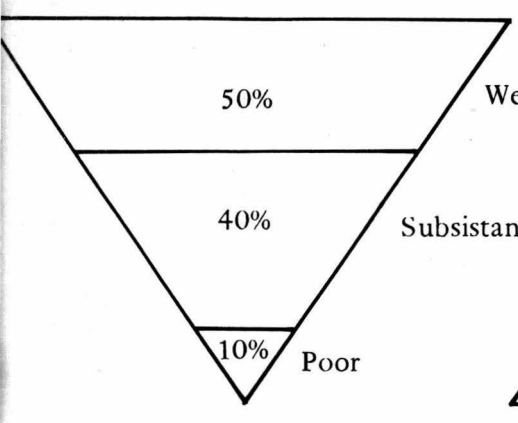
Young (1974) noted that, in some areas elephants and buffalo generate the main source of income for Karen. Prosperous Karens often work with teak companies contracting work with them for the use of their elephants or working as mahouts.

Meo

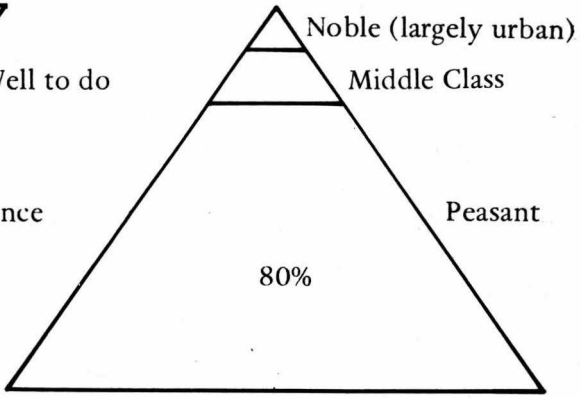
The Meo people with a population of about 30,000 make up about 11% of the highland ethnic minority groups population (TRC information). Villages are erected near the highest mountain tops at altitudes usually greater than 1200 m at the headwaters of a stream which is often named after the village. They are one of the least stable of the hilltribe groups and a Royal Thai Government survey in 1965 showed that 92.1% of all households surveyed had moved during the previous 10 years. Some of the reasons for these regular removals are: exhaustion of the soil, war, legal insecurity, high taxes levied by Governments, epidemics or the shaman's prediction of evil befalling the village (Walker, 1975).

Meo are "in the upper income group" of hilltribe peoples both through the cultivation of opium and other agricultural enterprises and their keen business sense. They are said to be "keen animal husbandrymen" with some knowledge of mixing rations to increase the nutritive value of poultry and pig feeds (Young, 1974) although such an observation does not apply generally.

Meo society is apparently less class structured than lowland society and Wongsprasert (1975 a) presented the following diagrams which indicate the relative distribution of wealth within both societies.



Meo Society



Lowland Society (Thai)

Cattle are kept to fulfil the social or religious obligations of sacrificing animals upon the death of a parent. Wherever possible the custom is followed and in the case of large, wealthy families up to twelve cattle may be killed in one ceremony.

Buffalo are kept by some Meo villages but are seldom used for sacrifices. They are kept for renting to lowland farmers in the rice season by some enterprising Meo. In some villages, Meo expressed the opinion that buffalo are more easily stolen than cattle because they tend to wander further from the village.

In one Meo village, Ban Nong Hoi cattle were slaughtered for local meat consumption. This practice was not common to other Meo villages and was probably precipitated by a decision of this village to cease cattle raising because of the frequency of crop damage by cattle in this relatively densely populated area. These villages were still interested in cattle raising but were not willing to put in any extra time or any investment in the form of management inputs to ease their problem.

Lahu

The Lahu people make up 6% of the population of highland ethnic minority groups with a population of about 17,000 (TRC information).

Lahu villages tend to be situated below the summits of the higher ranges at altitudes greater than 1000 m. The Lahu are generally pioneer swiddeners who move their villages when the soil fertility in the area has become exhausted. Large variations in the attitudes of the Lahu to livestock have been encounted. For example, some Lahu beliefs link losses of livestock to predators with cases of suspected adultery which requires some punishment to the offending persons, while in other villages, as Young (1974) noted in a Lahu village in the Fang district north of Chiang Mai, contracts were made with lowlanders for the agistment of cattle and buffalo for fattening, receiving as payment, one calf for every ten animals fattened. In general Lahu people seem to be raising more cattle each year and the sacrificial use of cattle (if ever - important), has long been abandoned.

The elevated design of Lahu houses provides opportunity for above average housing of livestock and in some cases seems to have encouraged other improvements in the management of large ruminants.

Christian Lahu villagers tend to have had a longer history of contact with outside ideas than animist Lahu and management methods of Christian Lahu reflect this in some ways. At Ban Huai Tat an instance of culling a cow with poor reproductive history was recorded. Christian Lahu do not grow opium and are therefore interested in all alternative forms of income. In the case of Ban Huai Tat, the village cattle population is relatively low due to the area for grazing being restricted by the activities of the Raming Tea Company and the Department of Public Welfare. A previous attempt to raise cattle in another area by these villagers was described by Keen (1972) in which 86, two and three year old cattle from Burma were bought at below-Thailand-market prices with some money earned from agricultural crops and some from loans. The six owners viewed the cattle as an investment for resale at a profit and it seemed possible that the invested capital may have been doubled within two or three years. This scheme, unfortunately had to be abandoned by the villages when several cattle died from suspected poisoning.

The animistic Lahu may also show initiative in their stock husbandry as in the case of Mae Pun Luang villagers; where they have developed their own cattle production system from which is derived, in same cases, substantial incomes by highland standards. Cattle are raised for sale of lowland farmers for draft purposes. Those cattle sold are for the most part males, and periodically females are purchased by the villagers to maintain the herd size. Thus a total bree-

ding herd of some 60 head is maintained without the problems of overgrazing commonly encountered in villages where cattle are raised but seldom sold. The Lahu studied by Walker (1970) did not milk their cows, use bulls for draft or pack purposes or consume much beef. There was apparently no prohibition on the consumption of beef but it was regarded as sinful to kill an ox and thus there was not a ready supply of meat.

Castration of some bulls is also practised in some Lahu villages although it is not employed as a breeding management tool.

Yao

The Yao people make up about 7% of ethnic-minority groups in the highlands with a population of approximately 21,000 (TRC information). They are situated mainly in Chiang Rai and Nan Provinces at lower altitudes than the Meo or Lahu villages. They are usually situated along stream headwaters although whenever the Yao have the opportunity, they seem to prefer to move to lower valleys and plant wet rice and vegetables. Once located near the lowlands the village usually becomes permanant. The Yao are considered to be the most advanced, sophisticated and business-minded ethnic group found in the highlands (Young, 1974; Walker, 1975) with the probable exception of Yunnanese Haw population resident in the highlands.

At the Yao village of Ban Pha Deua cattle raising had recently been abandoned due to problems associated with restricted grazing areas such as damage to crops when hungry cattle broke into cropping areas. Such losses caused by cattle led to the introduction of a system of fines based on the loss sustained by the crop owner, assuming that he would obtain a successful harvest. The Yao also expressed the opinion that cattle are less useful than buffalo because buffalo can be used to cultivate paddy fields as well as producing offspring for sale. Buffaloes were also less likely to damage their grazing areas because they are more easily trained and tread more carefully.

Animistic Yao prefer to sacrifice swine or poultry to cattle or buffalo for special religious events because of the high price of cattle and buffalo. Special days such as their lunar New Year may be celebrated by killing a cattle or buffalo beast for a village feast.

Cattle or buffalo raising was considered to be valuable enterprise by most Yao although they considered that the quicker return to labour possible from crops to be preferable, despite the harder work required to produce crops.

Lisu

The Lisu people make up about 4% of the ethnic minority groups population of the highlands with a population of approximately 11,300 (TRC information). Their villages, which are found mainly in Chiang Mai Province, are often situated on ridge tops at elevations of 1200 m or more. The Lisu prefer to settle in areas where the soil fertility has been proven by some other pioneering groups. Villages tend to more permanant than those of the Meo and Lahu, and this can lead to the erection of some fences around houses to prevent cattle damaging houses. Considerable numbers of cattle are kept by Lisu people and efforts are made continually to increases the herd sizes (Young, 1974).

In Ban Doi Sam Muen the large herd of cattle, some 250 head, grazed completely unattended. Gifts of cattle between relatives for events such as weddings can lead to a fairly wide distribution of ownership of cattle in Lisu villages. Low levels of management seem to be the rule although in village of Ban La Pa Ta, roofed nightyards for cattle have been erected by at least two owners.

The Lisu do not usually sacrifice cattle and are likewise reluctant to kill cattle for meat or even to sell cattle. The reasons for the keeping of large herds of cattle in Lisu villages are not entirely obvious, particularly when the number are well above those that can be easily managed in one area. The large cattle herds often sustain large losses to thieves, predators and diseases which is most probably a function of both their size and management input.

Akha

The Akha people make up about 3.5% of the ethnic minority groups of the highlands with a population of approximately 10,200 (TRC information). Their villages are found mainly in Chiang Rai Province situated on ridges but not at the highest point, at elevations of about 1100 metres. Village sites are changed every 10-15 years on average.

Young (1974) noted that the nature of Akha people is to be timid and friendly although frightened of outsiders. They associate outsiders, especially people coming from the lower elevations, with evil spirits and bad luck. Nevertheless, Young says they do not usually like to venture out of their village area even for trade purposes, although recently many more have become accustomed to lowland trading.

The Akha keep cattle and buffalo to produce income and for use in religious sacrificial ceremonies. Usually one beast is sufficient for the death of one person and a distinction is made between the role of cattle and buffalo. Some breeding management may be practised in the sale or slaughter of old bulls or cull cows. The Akha recognized that greater income could be generated from cattle but no real moves in this direction were in evidence. Buffalo raising was generally prefered to cattle raising because high rates of return could be obtained from hiring them out to lowland farmers for the cultivation of rice paddies or for working the paddy fields owned by some Akha villagers.

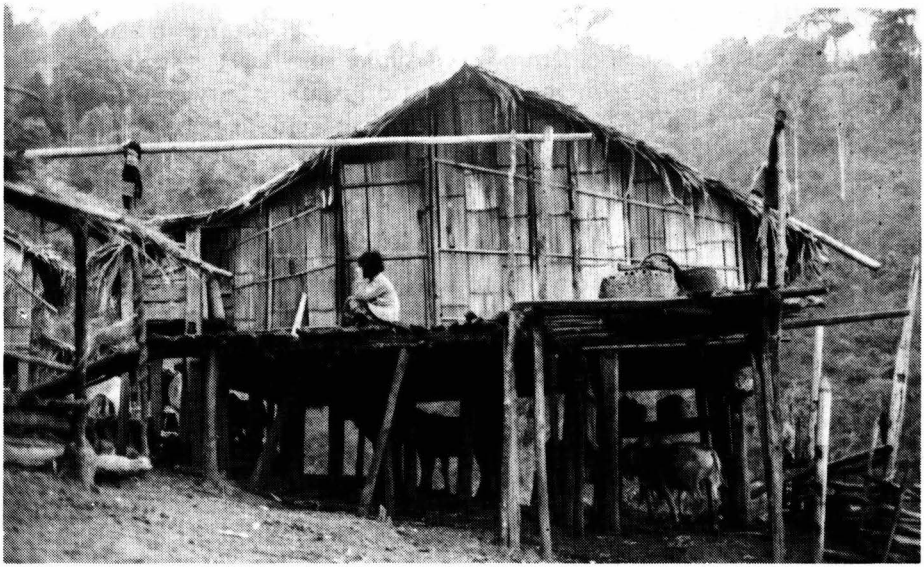
The comment by Young (1974) that the Akha are among the more backward and primitive people does not necessarily apply to the aspect of cattle and buffalo raising.

Yunnanese Haw

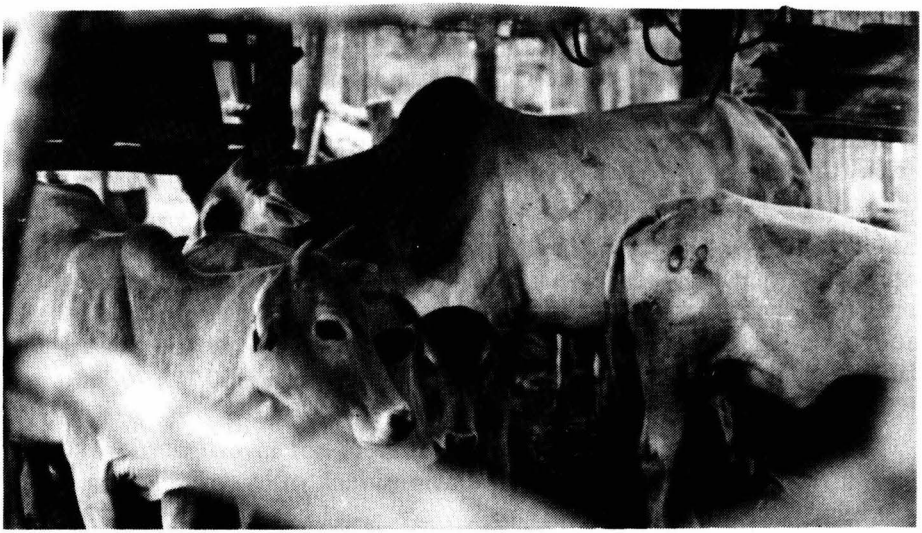
Young (1974) has stated that "the most important Haw settlement is found on Doi Pha Luang (elevation 1800 m) Amphur Fang, Chiang Mai Province. These Haw tribesmen have introduced a system of mountain agriculture using a type of plough which they brought from Yunnan which might prove in future to be of great importance of using various grain crops such as buckwheat and their native varieties of sorghum. In addition, they practise very good systems of animal husbandry and demonstrate excellent examples for improved agricultural methods to the people around them".

The level of animal husbandry of the Yunnanese Haw is obviously higher than that of other highland peoples. However, no large numbers of cattle and buffalo were found to be tended by this group, even though Young (1974) lists cattle as a minor occupation of the Haw, Yao and Lisu but not the Meo.

Other ethnic groups of the highlands were not investigated in these surveys due to their small populations, lack of large livestock or similarity to other ethnic groups.



A typical Lahu house showing the shelter afforded cattle during the night. The close association with the cattle encourages better care of cattle in some cases.



Highland cows with a 75% Brahman bull in a corral built as part of a cattle development programme. Brahman bulls have been introduced as improved sires to increase the size of native cattle.

SACRIFICIAL USE OF LIVESTOCK

SACRIFICIAL USE OF LIVESTOCK

Livestock are kept by some ethnic groups primarily to fulfil sacrificial obligations on the death of a person in accordance with their animistic beliefs. In terms of numbers sacrificed, pigs and poultry are by far the most important species in these roles; however, in terms of capital value cattle and sometimes buffalo are often more important. In Lahu, Yao, and Karen villages sacrifices involving cattle and buffalo were not encountered in these surveys. In Yao villages, cattle or buffalo may be slaughtered on important festival days to provide a feast for the village, but no slaughter of large livestock was required on the death of a relative. In the past, Yao people may have sacrificed cattle and buffalo but nowadays the Yao people interviewed on this subject considered that the practise was not only unnecessary but also wasteful on economic grounds. According to Roth (1974), sacrificial practises are declining over recent years, presumably concomitant with increased contact with other civilizations.

The main ethnic groups that participate in sacrificial ceremonies involving cattle or buffalo are Meo, Akha and Lisu. Young (1974) stated that Meo and Lisu sacrificial customs were similar although in the present surveys cattle or buffalo sacrifice in Lisu villages was not recorded. The usual Meo custom is for the children of a diseased parent to each sacrifice one cattle beast. In the Meo village of Ban Nong Hoi a total of eight cattle were sacrificed in the ceremony following the death of an important woman in the village in 1975; another incident involved three cattle, ages four two and one years old, buffalo ages six, four, and one years. Over a two year period a total of at least 17 cattle plus an unspecified number of buffalo have been sacrificed for religious purposes in that village. This is a higher than average figure for all but the richest Meo villages and may be connected to the villagers' desire to cease cattle raising due to the problems of tending cattle in a more highly populated area. Wongsprasert (1975) records that, on the death of a senior Meo man in Ban Mae Sa Mai, his children and close relatives sacrificed five large pigs, four cattle and one buffalo. His clan members, some of whom lived at great distance away, came to attend the ceremony which lasted about seven days.

In the Meo village of Ban (Old) Pa Kia, the death of the headmen's mother in 1976 precipitated the sacrifice of 11 cattle. The cost of ceremony and celebrations was further increased by the purchase of whisky and other items for guests. Ten of the cattle sacri-

ficed were in keeping with the traditional system of each child of the deceased parent sacrificing one beast. The additional animal was reportedly bought by all the children to ensure that there was enough meat available for the guests. Such a celebration reflects the high social standing of this family in the village.

Later in the same village an epidemic took the lives of 10 villagers ranging in age from one and a half to 60 years including apparently healthy young men. Cattle, to a total of six head were sacrificed upon the deaths of adults while pigs were employed in the cases of children. Cattle for sacrifices were bought within the village or donated by relatives. The details of these events appear in Table 7.

Table 7 Details of Deaths and Associated Sacrifices in Old Pa Kia (Hoare and Thanyalappitak, 1977)

Name of deceased	Age	Sacrifice offered and source
Paw Sae Hang	45 years	1½-2 year old cattle beast purchased from headman for 1000 B
Son of Chan Sae Hang	1½ years	one small pig
Son of Chan Sae Hang	2 months	two small pigs
Daughter of Cahn Sae Hang	5 years	two small pigs
Jang Sae Tao	-	-
Daughter of Ya Lao Lee	-	two small pigs
Nang You	20 years	one cattle beast owned by the husband of deceased
Nang Sai	60 years	two, 1-2 years old cattle, one bought from the headman and one bought from the headman and one from another source. Three pigs were also sacrificed.
	Adult	two cattle beasts

Such sacrifice is believed to enable the spirit of the sacrificed animal to accompany the spirit of the deceased Meo on its passage. A family which does not own cattle or buffalo feel obligated to buy them in order to discharge their committment, although very poor families must try to make do with swine and poultry only. The Meo do not like to utilize goats in the sacrificial role because they believe that their cries while being slaughtered may offend the spirits. Meat of animals is largely consumed by the guests present at the funeral ceremony with a certain proportion reserved for the spirits.

In Akha villages, the family of a deceased person will try if possible to sacrifice two cattle which provides a feast for everyone present at the funeral celebration. Buffalo, and in very special circumstances a horse, may also be sacrificed. The buffalo meat cannot be eaten by members of the household of the deceased. As with the Meo it is believed that the spirit of the sacrificed buffalo will be a companion for the spirit of the deceased person. Cattle on the other hand, are slaughtered solely to provide meat. Horses, when sacrificed, are not eaten. The usual sequence of events following the death of an Akha villager is for the corpse to be kept for seven days in the house and for poultry, swine and in some cases, goats to be sacrificed daily. Buffalo and cattle are not sacrificed until the seventh and last day. If the family of the deceased does not own cattle or buffalo they must buy in animals for sacrifice. However, as with the Meo, a very poor family may forego the sacrifice of cattle or buffalo.

Sacrificial use of large livestock by Lisu people is not very common. The practice seems to have decreased in frequency over the last 50 or 80 years and may be related to the strong desire of the Lisu to accumulate large herds of cattle. Nowadays cattle may occasionally be sacrificed on the death of a senior male person or at some period after his death, often seven years, to call his spirit back to the house of his family when an altar is erected. The sacrificed beast is eaten by all participants in the rite.

MANAGEMENT OF CATTLE AND BUFFALO

MANAGEMENT OF CATTLE AND BUFFALO

The level of management of livestock by highland dwellers is low. In the case of ruminants the inputs are usually lower than the already low inputs for poultry and swine. For instance, Cockrill (1974) has noted that buffalo calves up to six months of age require special care because they are subject to neglect, injury and disease and, as no such care is usually offered, the incidence of buffalo calf deaths is often quite high.

No additional feed was found to be offered to ruminant livestock. However horses and mules which are kept for pack purposes complementary to the pack purposes of cattle often receive special treatment to maintain them in good condition. Grass species more nutritions than Imperata are collected and sometimes transported by horseback or on the backs of villagers themselves to the village to feed the horses and mules. Salt may be offered to cattle, buffalo and goats as a means of quietening animals and encouraging them to return to the village each evening. Salt may be fed by hand in crystalline form or from a bottle with a small opening containing a saline solution. Villagers in most cases recognized the dry season as the most trying period of the year for livestock but in no cases did they consider this a real problem by itself. In areas where replanting of forests had encroached on cattle grazing lands, villagers recognized feed shortage during the late cool-dry-season as an increasing problem. The problem, however, was not that of concern for the well being of cattle but of concern for crops damaged when hungry cattle entered cropping areas. Later in the hot-dry season no crops are grown that can be damaged and preparations for subseguent crops involved burning which produced a green pick for cattle to graze. Management strategies aimed at overcoming this are orientated toward the crop and not to cattle. At Ban Doi Sam Muen villagers have their cropping fields extending in one direction from the village while cattle can go out to graze in the other directions. Gates across paths, although not necessary connected to a continuous fence and deep ditches, are also sometimes employed to keep cattle out of cropping fields.

Medical treatment is seldom offered to sick or injured stock. In some villages, the assistance of the amphoe Veterinarian was sought to tend sick livestock but this was usually only in cases of epidemics. A single animal sick was not usually sufficient reason for a visit to the

amphoe office, especially when the veterinarian may not be available to visit the village at that time. In some instances, medical treatment was offered by villagers themselves. For example; in one miang village, injections of an unknown drug were given to cattle when they became ill. This however reflected the initiative of an absentee owner who had provided the materials and drugs with instructions for their use with his cattle when they were agisted to that village. In other instances, wounds of cattle were treated with petrol in one village and kerosine and a mixture of plant leaves at another. The application of a mixture of native peach tree leaves and dried tobacco leaves to wounds that had become infested by screw worm or warble larvae was also practised. All the above medical treatments were practised by Khon muang people who usually have a greater contact with outside ideas than other highland peoples.

It is common practice in the highland regions for the cattle to return to the village each night, where they may spend a total of between 12 and 17 hours; in some case, they must be chased out to graze in the mornings. During this night time herding the cattle do not usually have access to water, a factor that may affect grazing patterns especially during the hot season. However under normal circumstances the incidence of watering by cattle during darkness is apparently minimal (Hafez and Bouissou, 1975). Cattle may be physically restrained during the night, as for example in Lahu villages where cattle are often tied up under the elevated houses, they may be herded or trained to return to their owners house but not restrained or they may simply camp in the common area of the village near the houses. The houses of rich persons in a village can often be determined by observing the relative amount of cattle dung deposits around each house. In some villages, cattle do not return to the village every night, for example at the Lisu village of Ban Doi Sam Muen where the herd is so large that cattle must travel long distances from the village to graze. Thus although some cattle are seen in the village most nights, it is unlikely that many animals return to the village every night. The low availability of surface water in that region during the dry season leads to a greater number of cattle returning to the village where there is running water during the hot dry season.

Tending of stock during their daily grazing routine also varies markedly. For example, cattle from the Akha village of Ban Saen Jai Mai are not usually tended and can graze at distances up to five kilometres from the village whereas buffalo kept in the neighbouring Akha village, Ban Saen Suk are tended constantly. Thefts averaged

four to five head per year for the untended cattle compared to nil for the tended buffalo. Closer tending of buffalo than cattle seems to be the general rule and this possibly reflects both the greater value placed on buffalo and the progressiveness of the buffalo owners. Buffalo are usually owned by villages that have paddy fields, and are utilized for working as well as yielding an income through the sale of progeny. Villages where paddy fields are owned are usually more progressive and have greater contact with lowland civilization which may encourage improved management techniques, but may also increase the need to guard against theft.

Fencing is usually only constructed to keep cattle out of cropping areas rather than restrain the cattle in a certain area. The Karen most commonly build fences although the Lahu may also build some less permenant constructions. Usually Meo people rely on the distance between the night camp of the stock and the swiddens as protection from grazing. Fences around Lisu houses are sometimes constructed to prevent cattle damaging the house when they attempt to graze the grass roofs. Ditches about two metre deep and one metre wide are also used around Lisu cropping fields to keep livestock out.

Input levels for the tending of stock in the highlands can be divided into four approximate catagories:-

(i) No input. Stock can leave the village at will and similarly return at will. This system allows stock to stay away from villages overnight and, in extreme cases, some stock may never return to the village. Stock losses under this system are high.

(ii) Stock are brought back by villagers, often children, to the village each night. No one tends the cattle during the day and thus occasional stock losses can occur.

(iii) Medium Input. Stock are tended while grazing, often by children, and are brought back to the village each night. In one Yao village, a cattle owner considered this level of management necessary and had hired labour to perform this task. Stock losses under this system are minimal.

(iv) Maximum Input. Stock are tethered in tobacco fields or unused paddies during the dry season and someone watches the stock all day while performing other agricultural tasks. The stock are brought back to the village each night and losses are very rare.

In the Meo village of Ban Nong Hoi cattle were not tended by some owners because, they say, if the cattle were tended, they would

become quieter and would thus be more easily led off by thieves. This strategem may reduce the incidence of thefts from the village but could act to encourage shooting of cattle for meat by thieves when the cattle are for from the village and untended. These villagers were trying to reduce their stock numbers, and thus their lack of care may have equally well reflected a lack of interest in livestock. When sold these cattle fetched lower prices than quiet stock because they were much more difficult to lead. Ear marks are also employed in this village in an attempt to discourage theft; however, this only protects live animals. Close tending appears to be the only realistic solution to the theft problem in the short term.

Tending of livestock is usually regarded as a menial task and therefore often assigned to children, who in some cases, could otherwise be at school. Other activities of the agricultural year are regarded as more important than livestock tending, especially in the case of cattle, and in times of peak labour demands for agricultural work, stock tending may be restricted. This practice, although placing at risk a considerable investment, is consistent with the general reluctance to sell stock except in times of need. That is, stock do not, at present play an important role in the regular economic life of the village. In some villages, labour inputs into stock-tending reflect a large interest in keeping stock out of cropping areas rather than an interest in stock per se.

Stock travel varying distances from the village of their owners to seek grazing areas, depending on the herd size and quality of the grazing available in the area. In most cases, small to medium sized herds of cattle graze within two kilometres of the village. During the wet season stock can usually find sufficient grazing in the immediate vicinity of the village; however, in the dry season the area ranged over must by necessity increase. In some situations, stock travel up to ten kilometres from a village and may only return to the village once every three or four days. Heavy grazing leads to the invasion of the native grass, Imperata cylindrica by unpalatable broadleafed weeds such as Eupatorium adenophorum and E. odoratum. This commonly leads to increasingly weedy areas close to villages. The actual speed of invasion of the weeds into native pasture seems to be a function of stocking rate, time and soil type while the species involved seem to vary with altitude, soil type and other factors.

Estimated stocking rates for the highlands vary from 7 to 25 hectares per beast for the highlands areas as a whole (Ashfaq, 1975; Snook, 1975) to 12 for the catchment area of the Mae ta Man river, Amphoe Mae Taeng, (Falvey, 1976) to 15 for a herd of cattle allowed

to wander freely over a very wide area at the research site of the Thai Australian Highland Agronomy Project. Estimates such as those of Wongsprasert (1977) of two hectares per head probably do not include the total region covered by cattle in the dry season.

Weaning of calves was not found to be practised in any of the highland villages visited. This factor is probably not of great importance at the present time because calving rates appear to be sufficiently high in any case.

Breeding management of large ruminants is likewise low. Castration is practised in some villages but the operation is usually performed after the animal has reached sexual maturity to ensure a strong, well muscled beast. Thus castration is not used as a management tool for breeding purposes. Some persons observed that castrated animals were more desirable for draft purposes than entires because their strength was more reliable than bulls that may be tired after mating and fighting. On the other hand, most owners considered that the operation weakened stock to too great an extent to compensate for the benefits of the operation. Castration of physically mature animals leads to the occasional death, which serves to discourage many persons from adopting the practise and has led to the misconception of the severity of the operation for young stock. Castration of young stock was not usually practised even when recognized as a minor operation, because it was said to retard muscular development.

In the Lisu village Ban Na Law, larger bulls were said to be castrated (up to 50% of the bulls in the herd) because villagers had observed cows falling over under large bulls and in some cases becoming injured. The uncontrolled mating system of cattle in this and most other villages can lead to almost continuous mounting of cows on heat which tends to tire the cow and prevent her from grazing very much. The larger bulls are really just the last straw on the cows back, and the mating system is at fault. In fact, castration of heavy bulls is probably less desirable in terms of growth rates and marketability than no castration because small animals are not as suitable for draft purposes. Rufener (1971) noted a similar outcome in Thai villages in north-east Thailand where attitudes vary from the highland situation when larger cattle were castrated to render them more docile and thus easier to sell both for draft and meat purposes. In the case of buffalo in lowland areas, larger males are often castrated for draft animials leaving only inferior sires. To compound this problem, female buffalo are being slaughtered for meat because they are

cheaper than males. Thus the overall fate of the Thai buffalo could be a decrease in both size and numbers.

The wider role of castration in management is beginning to be appreciated in the highlands. In one village castration was said to be practised to fatten animals for sale. In some of the villages where Brahman bulls have been donated as part of the Royal Hilltribes Project, castration of some native bulls is said to have been practised.

Three different methods of castration were found to be practised in the highlands. The first was similar to the common practise of removing each testicle through a cut in the scrotum and severing the testicle from the vas deferens and blood vessels. The second involved complete removal of the scrotum and testicles using a sharp knife. This leads to much bleeding but apparently little infection and stock losses to this method were neglible, as with the previous method. The third method, by far the most popular, employed two hinged pieces of wood. The pieces of wood are placed either side of the scrotum above the testicles and clamped together. The upper piece of wood is then struck with a rock or hammer-type object until the vas deferens and blood vessels are crushed. If successful the testicles gradually decreased in size until they are fully resorbed. This method is unneccisarily cruel and is not completely reliable. Extension agents assisting agricultural development schemes prefer to use Birdizzo-type emasculators.

Castration operations were performed either by the owner of the animal, or more commonly by one or two persons within the village who had aquired special skills in this field. In one case, a person was hired from outside a village to perform the operation at a fee of 30 baht per head.

Bull to breeder ratios for both cattle and buffalo are low. Survey data indicates a ratio is about 1:4.3 for cattle and 1:2 for buffalo. A small proportion of the bulls included in these calculations may have been castrated, but nevertheless, the ratio of bulls to cows would not be expected to exceed 1:5 for either cattle or buffalo. It therefore appears that there is some scope for selection and breeding within the native herds through castration of inferior bulls. Cockrill (1974) suggests a bull to breeder ratio of 1:12 for buffalo, which is significantly lower than the commonly recommended ratio for cattle but still higher than that in the present situation. Some of the problems of excessive bull numbers have been discussed previously. An extreme example of overcoming any such problem was encountered in the Lahu village Ban

Ja Phuu where no female buffalo are kept at all because the villages dislike the fights that occur if both males and females are kept. This of course minimizes the potential income that can be derived from buffalo.

The herd structures in some villages are presented in Table 8. There is no general trend in herd structure obvious from the table which may be attributed to the different economic systems of different villages and to a lesser extent, confusion over the distinction between heifers and cows. The mean herd structure determined from the data in Table 8 is presented as figures 10 and 11.

Perhaps a more accurate picture of herd structure can be obtained from figures 12 and 13 which are derived from; reproduction rates, incidence of purchases, age of animals purchased, incidence of sales, ages of cattle sold, ages of cattle slaughtered, and incidence of stock losses. The major influences on the average distribution are deaths and sales. In general, male cattle are sold before females and this is also often the case with buffalo kept for sale as well as for work, However, villages where buffalo are kept primarily for work purposes may prefer males and thus the relative proportions of males to females for buffalo is more even than that for cattle.

Table 8. The herd structures of cattle and buffaloes in some villages surveyed

Village	Cattle				Buffaloes			
	Bulls	Cows	Heifers	Calves	Bulls	Cows	Heifers	Calves
Ton Kham	-	24	-	15	6	15	n.r.	8
Mae Ta Man	14	-	-	-	9	30	15	1
Thung La Khon	2	32	n.r.	19	23	44	n.r.	25
Pang Mae Ta Man Nok	2	7	5	5	-	-	-	-
Pang Mae Ta Man Nai	19	6	3	6	-	-	-	-
Phapujom	2	12	7	10	1	-	-	-
Huai Tat	3	6	6	6	-	-	-	-
Mae Mae	3	36	n.r.	16	-	-	-	-
Mae Kok	4	7	4	7	-	-	-	-
Old Pa Kia	9	18	9	17	-	-	-	-
New Pa Kia	2	5	2	5	-	3	1	6
Mae Pun Luang	-	63	28	36	1	18	11	15
Yang Ha	2	23	8	17	-	-	-	-
Pang Kia	1	2	3	2	-	-	-	-
Mae Chang	6	13	3	16	5	19	4	17
Doi Sam Muen	38	99	19	7	3	6	-	6
Khun Wang	30	56	12	21	5	4	2	-
Pui (site A)	6	27	24	35	-	-	-	-
Buak Jam	4	6	4	5	-	-	-	-
Nong Hoi	9	41	26	45	8	10	9	10
Saen Jai Mai	1	22	-	18	-	-	-	-
Law Sii Kuay	-	-	-	-	4	11	-	3
Ja Phuu	-	-	-	-	42	-	-	-
Saen Suk	-	-	-	-	5	28	-	25
Huay Kang Plaa	2	6	-	4	2	-	-	-
Total	159	511	153	312	114	188	42	116

n.r. = not recorded.

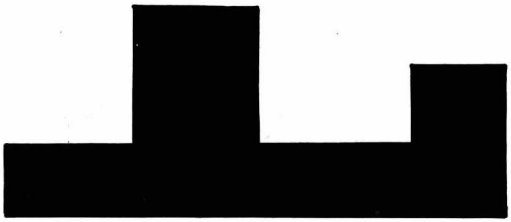


Figure 10. Mean herd distribution by sex and catagory for highland cattle.

Figure 11. Mean herd distribution by sex and catagory for buffalo.

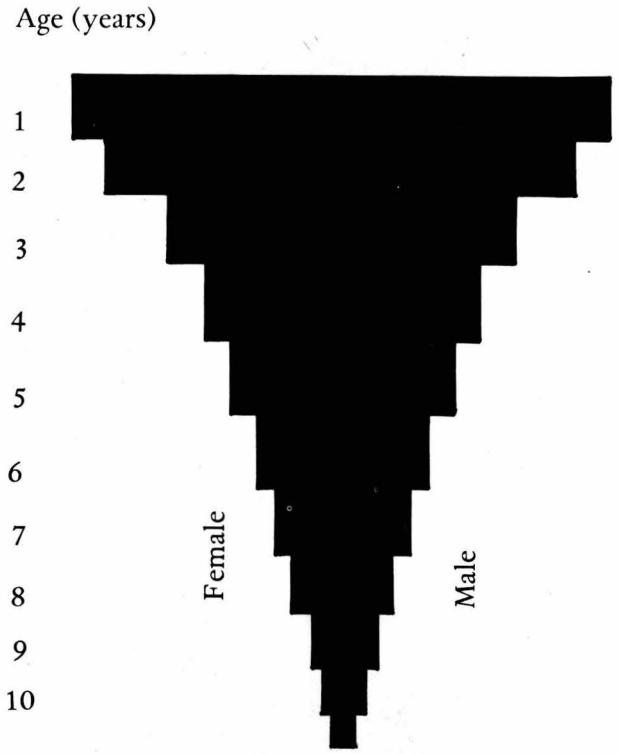


Figure 12. Estimated herd distribution of cattle by age in highland villages.

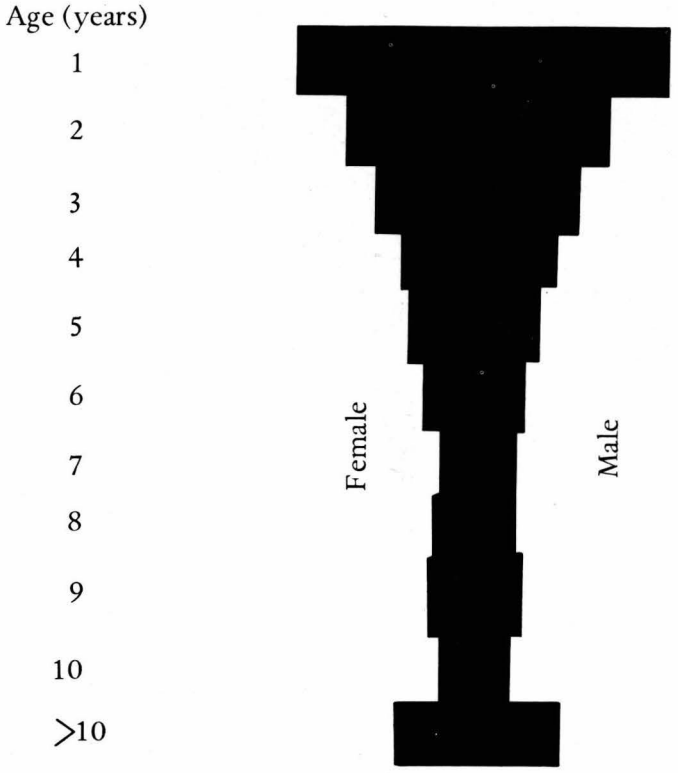


Figure 13 Estimated herd distribution of buffalo by age in the highlands.

PROBLEMS OF THE HIGHLAND RUMINANT INDUSTRIES

Disease

Theft

Predators

Other problems

PROBLEMS OF THE HIGHLAND RUMINANT INDUSTRIES

The ruminant livestock industries as they exist today in the highlands have evolved over a long period of time under the constraints of the area. Three of the main constraints are disease, theft and predators. Other problems encountered in the industry are minor in comparison to the losses that can be attributed to these factors. Cultural constraints, which may be of greater importance than technical constraints to the development of ruminant industries are not included in this discussion.

Disease

Cockrill (1974) has noted that in general buffaloes are more suseptible to disease epidemics than cattle,a finding supported by the survey. However the incidence of disease epidemics in the highlands seems to be low, possibly because of the localized nature of the industry around villages with only limited contact between the livestock of different villages. Symptoms approximating those of Haemorrhagic septicaemia to which buffaloes are probably more suseptible than cattle, were described by owners of cattle and buffalo in a few villages. A vaccination programme has been initiated in the lowland areas against this disease but as yet only a small number of highland herds have been vaccinated. Vaccinations are recommended every six months which is difficult to maintain in most highland villages under present conditions. According to Cockrill (1974) draft animals are particularly suseptible to this disease. Foot-and-Mouth Disease was commonly mentioned by villagers as a potential problem. The actual incidence of this disease however, seemed to be much less than may be commonly believed. Villagers often told of a village in a different area that had encountered Foot-and-Mouth Disease but first hand accounts of the disease were much less frequent. In the Lisu village of Ban Doi Sam Muen the outbreak of disease, probably Foot-and-Mouth Disease, in 1974 caused the death of about 10% of the herd. Other reports of the disease indicated that usually only a proportion of the herd may actually die from the disease. Brucellosis or contagious abortion is possibly responsible for some of the abortions recorded in the survey work. The incidence of brucellosis has been said to be significantly higher in cattle entering Thailand from Burma. An incidence of about one in 80 has been found in cattle bought from various areas of the highlands by HAP. In one group of cattle that entered Thailand from Burma the incidence of Brucellosis reactors was said to be greater than 50%. Some abortions in buffaloes are probably caused by the fact that they

are often required to work during late pregnancy. White scours was almost invariably linked with the deaths of young calves, in particular buffalo calves which may reflect poor management of young stock. A skin disease, possibly Sarcoptic mange, was encountered in the buffalo herd of one village where the whole herd was affected and some buffalo died. Deaths were possibly due to a combination of inadequate nutrition and secondary infection by screw worms or warbles of the open wounds resulting from the buffaloes rubbing against trees etc. in an attempt to relieve the skin irritation. Screw worms or warbles were also of importance in young stock born during the warmer months of the year. Infestation of the navel was recorded as the cause of some young calf deaths. Pink eye was encountered in some areas but the incidence was usually low. One owner believed that the incidence of this disease varied with the area where cattle were tended, which could conceivably be a genetic effect increasing the suseptibility of certain inbred herds. Internal parasites were probably not a serious problem in highland cattle and buffalo. The principal parasites encountered in research at the Thai Australian Highland Agronomy Project Field Site were Paramphistomum spp., Trichostrongylus spp., Strongyloides spp., Coccidia spp., and Fasciola gigantica. These parasites have mainly been observed in sheep in which levels of infestation were very much higher than in cattle. The low stocking rates and usually good condition of the stock militates against any rapid build up of internal parasite populations.

In an experiment with sheep in the highlands it was found that reproductive rate was 58% higher in group of sheep receiving regular anthelmintic treatment and that mortality in the untreated group was 25% compared with nil in the treated group. Faecal egg counts indicated that infestations may be higher during the wet season. Liveweight gains of the remaining sheep and their pairs were not significiantly different except during the wet season in one group of sheep (Falvey and Rietschel, 1977). Other diseases, such as, black leg and vibriosis have been suggested to be of possible importance to highland cattle (Coates, 1974),

Theft

Theft of livestock was found to be roughly correlated to the proximity of villages to lowland areas or to roads with variations being, in the main, attributable to the care taken in tending stock. In the Lisu village Ban Na Law, thefts were said not to have been a problem until recently when a road was constructed nearby. Stock may be led away to be tended by the thief or sold, or more commonly,

shot and butchered and the meat sold. The price obtained for the meat or for live animals is very low compared to the market price because the purchaser suspects that he is receiving stolen property. This activity is most wasteful not only because the price obtained is low, but because in many cases, breeding cows are shot for meat. In one village, a stolen cow was offered back to the owner for a sum of money: a ransom payment. The activities of Meo villagers in Ban Nong Hoi of ear marking cattle and not tending cattle closely thereby letting them become wild, may in fact provide an ideal opportunity for thieves to shoot the cattle.

In most instances thieves were said to be Khon Muang people who live in the lowlands or lower altitudes of the highlands. In one instance, however, conflict between the two Meo villages of Ban Buak Jan and Ban Mae Sa Mai had developed to the stage that thefts of small livestock occurred. Most highland people were reticent to reveal the identity of the suspected or in some cases, known thief of their stock. Hints of inter-ethnic group conflict caused by suspicions of the thievery were encountered but were devulged fully in only one instance at a social function after a long period of contact with the village.

Highland people in general, consider it futile to report thefts to the police. A small proportion of thieves are caught and their punishment has ranged from some private arrangement between the owner and thief which does not involve the police, to being forced to pay for the stock stolen or spend two years in prison. In one atypical instance where a cattle tender was shot dead and his cattle stolen, the thief was sentenced to 25 years in prison. The low probability of being caught and punished does not seem to serve as any form of deterrent to potential thieves. Thefts seem more likely to occur during the February to May period when many lowland dwellers do not have much pressure of agricultural work. Tending of stock is the most practicial answer to this problem of present, although determined thieves can usually scare cattle tenders away unless the tenders are armed.

Predators

Predators in the form of leopards and sometimes tigers are still a problem in the highlands. The incidence of attacks by predators is decreasing rapidly as the forested areas decrease and human population increases. At the present time, they are only a regular problem in the more remote villages although occasional attacks occur in more accessible areas. Large herds of cattle or buffalo often attract preda-

tors such as at the Lisu village of Ban Doi Sam Muen where the deaths of 17 head, mainly young animals, out of a herd of more than 250 head were attributed to predators. In the victinity of the Highland Agronomy Project research site, an area served by roads and without much forest, two tigers killed a total of at least two cattle, three horses and seven pigs at three different villages in three attacks spaced at intervals of about two weeks. The incidence of predator attacks is easily exaggerated however, especially in cases where cattle are not adequately tended. Predators are apparently shy of humans to a certain extent, and seldom attack stock while humans are present. Buffalo can apparently protect themselves against predator attack to a greater extent than cattle, thus less deaths to predators were recorded for buffalo.

Other problems

Other lesser problems associated with the present ruminant industries in the highlands are poisons (both naturally occuring and otherwise) and feed shortages.

The occurence of poisonous plant species has been suggested but not confirmed. If this is a problem it is probably limited to stock newly brought to the highlands, the existing stock having learnt to avoid poisonous species. Poisons are also sometimes associated with thieves or intervillage rivalry. A bait containing a form of cyanide is given to cattle by a thief who then may return the next day and ask to buy the meat of any animals that have died unexpectedly. The cattle owners, of course realize the situation but cannot prove their suspiciuns. The meat is not eaten by the owner of the cattle because he fears the poison, similarly the poisoner will not usually eat the meat but sell it, even though there is probably little danger in eating the meat. This practice is not widespread and if it occurs or is suseptced, the carcass in usually buried so that no one can buy the meat. This usually discourages any subsequently poisonings which could easily occur otherwise. This means of theft was supposedly one of the main reasons that a cattle development project in the Christian Lahu village of Ban Huai Tat, was terminated by the villagers. Other isolated incidents of poisoning have occurred in the highlands as recently as 1977. Where they are associated with intervillage rivalry the purchase of meat is not usually attempted.

Feed shortage is not generally recognized as a problem by villages because they have traditionally regarded ruminant livestock as being able to take care of themselves. Recently, however, the reafforestation projects of the Royal Forestry Department have increased vil-

lagers' awareness of the need for adequate grazing areas for livestock. The naturally occuring phenomenon of weed invasion that acts to restrict grazing lands is less easily recognized by highland people. Imperata cylindrica, the dominant species of the grassland areas in the highlands, is quickly replaced by unpalatable weeds of the Eupatorium genus. (E. odoratum at elevations less than 1,000 m and E. adenophorium elevation greater than 1,000 m) under conditions of heavy grazing. The pattern of weed invasion of villages that have owned cattle for several years is of denser weed invasion closer to the village where the grazing intensity is higher. Where goats are present the rate of invasion may be greater.

The problems of the ruminant livestock industry are not overpowering because the system has evolved subject to these constraints. If changes in the present system are intended based on say improved nutrition and or higher stocking rates, the problem of disease may increase although the problems of thefts and predators would possibly decrease in importance. In that case, social constraints such as attitudes to, and religious use of livestock would be of equal or greater importance. Technical problems such as inbreeding among village herds, and low management inputs may also arise.

THE BIOLOGICAL PERFORMANCE OF HIGHLAND CATTLE AND BUFFALO

Cattle

Buffalo

THE BIOLOGICAL PERFORMANCE OF HIGHLAND CATTLE AND BUFFALO

Previous knowledge of the produce tivity of cattle and buffalo in the highlands is scant and has been documented in three short paragraphs in a review on highland ruminants (Falvey, 1977). The follow ing information extends that knowledge and modifies material presented in that review.

This information concerning cattle and buffalo of the highlands was partly collected by asking questions of persons connected with livestock and then seeking to check that information. The accuracy of the answers given by stock tenders was in some cases,poor. This is easily understood in terms of the attitudes of the people to their ruminant livestock, in particular cattle. Traditionally cattle have looked after themselves; births, deaths, sickness, predators and, to a certain extent theft have been influences on the development of the system and thus people accept a certain level of loss each year with greater yearly variation.

Cattle

The range of replies given to questions related to the performance of highland cattle and the means of these replies are presented in Table 9. The slow rates of maturation suggest adaptation to the environment, however reproductive rates are not correspondingly low. No cattle tenders estimated the calving interval to be greater than eighteen months and the mean of the replies was 13.2 months i.e. an annual calving percentage of 91. This figure is probably very optimistic but nevertheless indicates that reproductive performance is potentially high. It is surprising that such a reproductive rate could be maintained under the conditions of low nutrition and minimal management and the figure probably reflects the average best performance remembered by the owner. The smaller size, and thus lower maintenance requirements and late age at first calving may favour a high reproductive rate. Calculation of calving rate from the age at first calving, the number of calves per cow lifetime and the length of a cows life yields a calving rate value of 60%. This figure is probably less accurate because cows are usually sold or killed at about ten years of age. A minimum calving percentage of 60% is indicated from Table 8 which reflects the herd situation and thus includes mortalities and losses to predators. Nevertheless this may indicate a marked reduction in the reproductive rate as the cows become older. In one village, a cattle owner proudly informed us that he owned a fourteen year old cow that still produced one calf every year.

Table 9. Biological data for cattle. Ranges and means from information obtained in suryeys.

Biological Parameter	Range of replies	Mean of replies
Age of heifer at first calving (years)	2.5 - 4	3.1
Months between calves	12 - 18	13.2
Month of peak births	all year	January, July
Length of life (years)	15 - 30	21.5
Calves per cow per lifetime	7 - 15	10.9
Years to reach full size	4 - 7	5.6
Length of heat (days)	2 - 3	2.4

Observations of herds of cattle in the highlands indicate that 80-90% of the younger cows in the highlands have calves at foot. It is quite common to encounter cows in calf still suckling young calves. On the other hand, cows that fail to conceive in the twelve months after giving birth may suckle that calf for up to three years.

Births were said to occur throughout the year although there was a suggestion by some cattle owners that there were two peaks of calving during the year, namely about January (cool dry season) and July (wet season). Records from the HAP research programme appear to confirm this pattern. The patterns of calving and rainfall incidence at the HAP (Pa Kia) field site are presented in figure 14. Conception must usually occur during the months of March (hot-dry-season) and October (late wet season). Conception at these times is most probably related to the improved nutrition provided after burning of pasture during the hot-dry season and by the wet season.

Recent investigations by HAP (Falvey et al, 1977) have produced a mean growth curve which relates the body weight of highland cows to age. This relationship, $W = -0.03351061\ a^2 + 5.0682\ a + 31.33$ where W is body weight in kg and a is age in months, is presented graphically as figure 15. This relationship is the first estimate of a growth curve for highland cattle. In the future more accurate descriptions for other catagories of cattle which will include more knowledge of the variation will become available. Until that time however, this relationship provides the most accurate means of estimating the age to weight relationship of highland cattle. The curve illustrates the low mature body weights and slow rates of growth of highland cattle. Peak liveweights at about

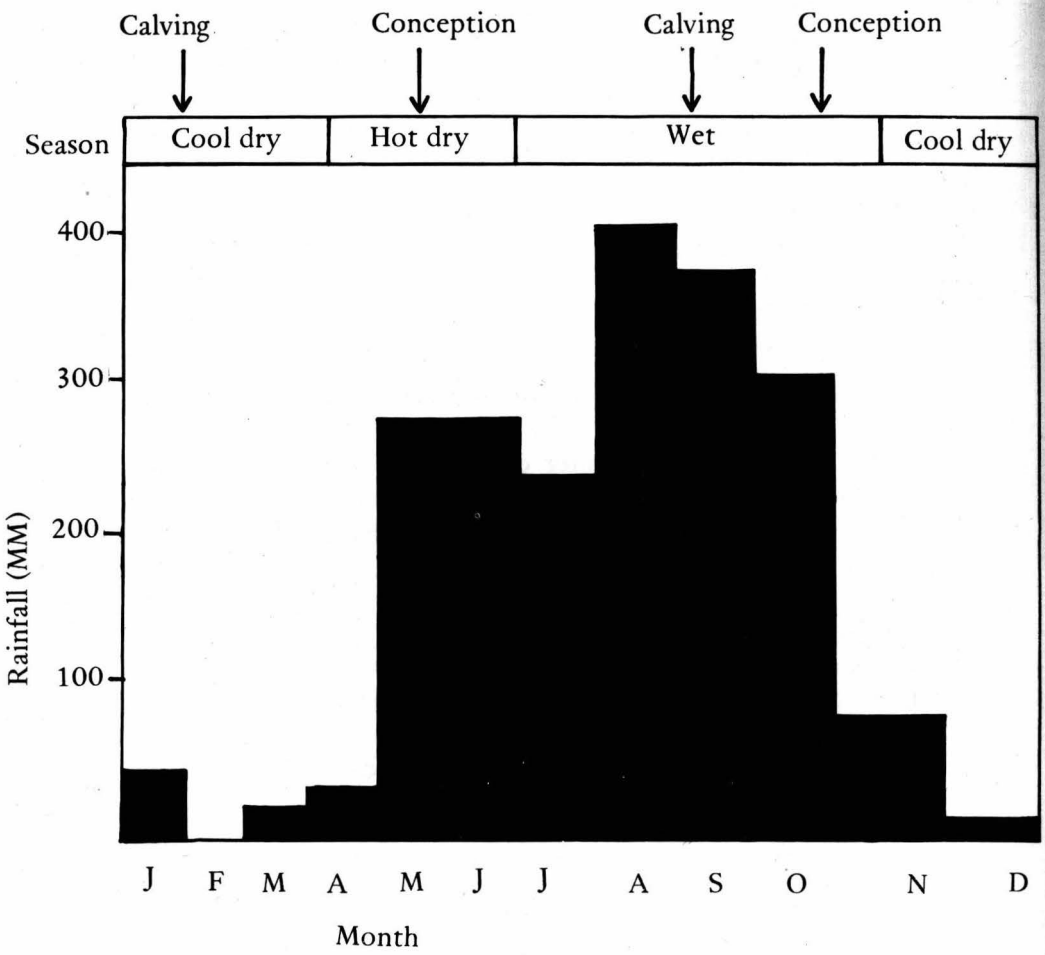


Figure 14. Rainfall distribution, seasonal and reproductive patterns of highland cattle at Pa Kia.

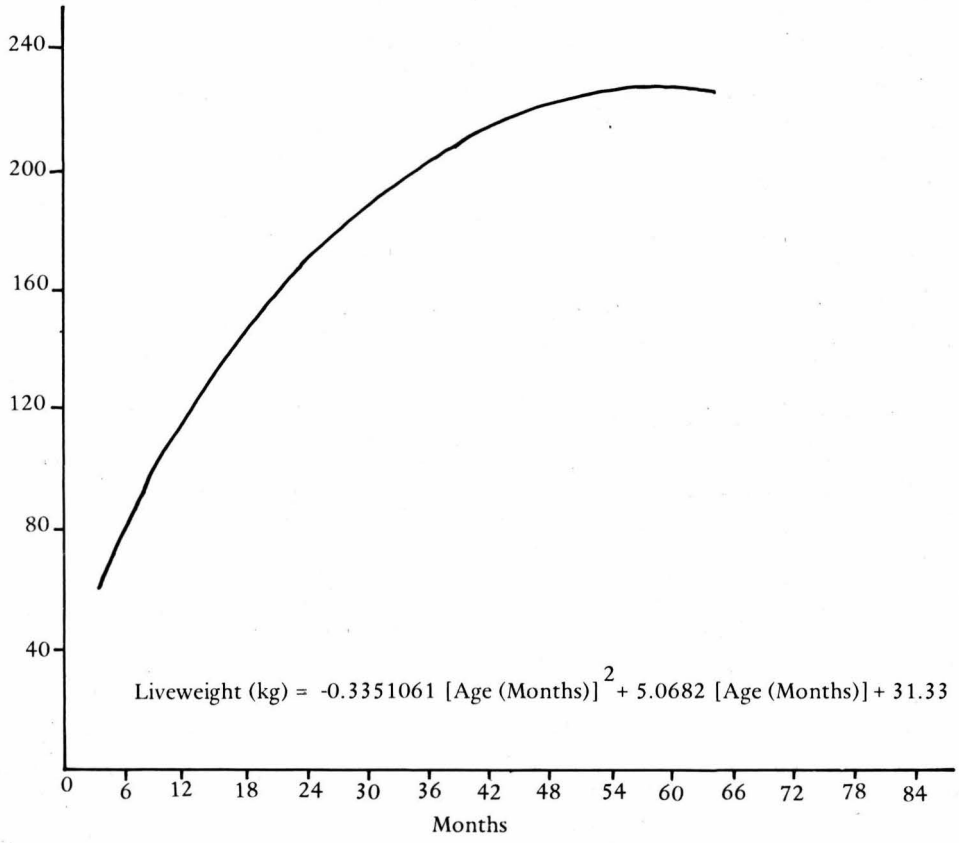


Figure 15. The relationship between age and weight for highland cows (Falvey et. al., 1977).

six years of age (of less than 250 kg) are in agreement with the information obtained in the surveys.

Another quadratic relationship which describes the relationship between liveweight and girth circumference for mature highland cows has been prepared for use in areas of the highlands where weighing facilities are not available. The relationship is,

$$W = 0.01015969\ g^2 - 0.0120\ g - 6.45$$

Where W is the liveweight in kg and g is the girth circumference in cm, and is presented graphically as figure 16. Inclusion of height in the relationship reduced its accuracy, possibly because some of the animals in the survey contained some proportion of lowland cattle blood, and height in particular leg length, is the most obvious physical difference between lowland and highland cattle.

Preliminary studies of the productivity of highland cattle under village conditions, also conducted by HAP at Pa Kia by Hoare et al. (1977), indicated birth weights of 11.0 kg for the typical highland cattle compared with 14.7 kg for calves born to lowland type cattle. Figure 17 presents the liveweight changes of highland cows over a 12 month period. Liveweight losses in cows over the dry season were greatest during early March while a large liveweight gain occured at the end of that month. The liveweight loss followed by liveweight gains were probably related to the burning of native pastures, an annual occurence, followed by the production of green shoots from the burnt sward. The liveweight gains afforded by this green pick decreased until the wet season began when they increased again and then gradually decreased through the wet season. During the late wet season liveweights were relatively stable. The pattern of liveweight changes of native cattle grazing native pastures seems therefore to be a function of both the quality and quantity of the pasture, quality being the prime influence. A schematic diagram of pasture quantity and quality is presented as figure 18 to illustrate the effect these factors have on liveweight gain (figure 17).

The suitability of lowland cattle to supplement the relatively low numbers of highland cattle in Thailand is also worthy of mention. Lowland cattle brought to the highlands require an adaptation period of at least one month. In many cases these longer-legged stock have such difficulty in walking on steep slopes that they are not able to find enough to graze and therefore become quite thin and, in some cases may die. Lowland cattle, especially those with a white coat colour also seem to be more susceptible to skin irritations.

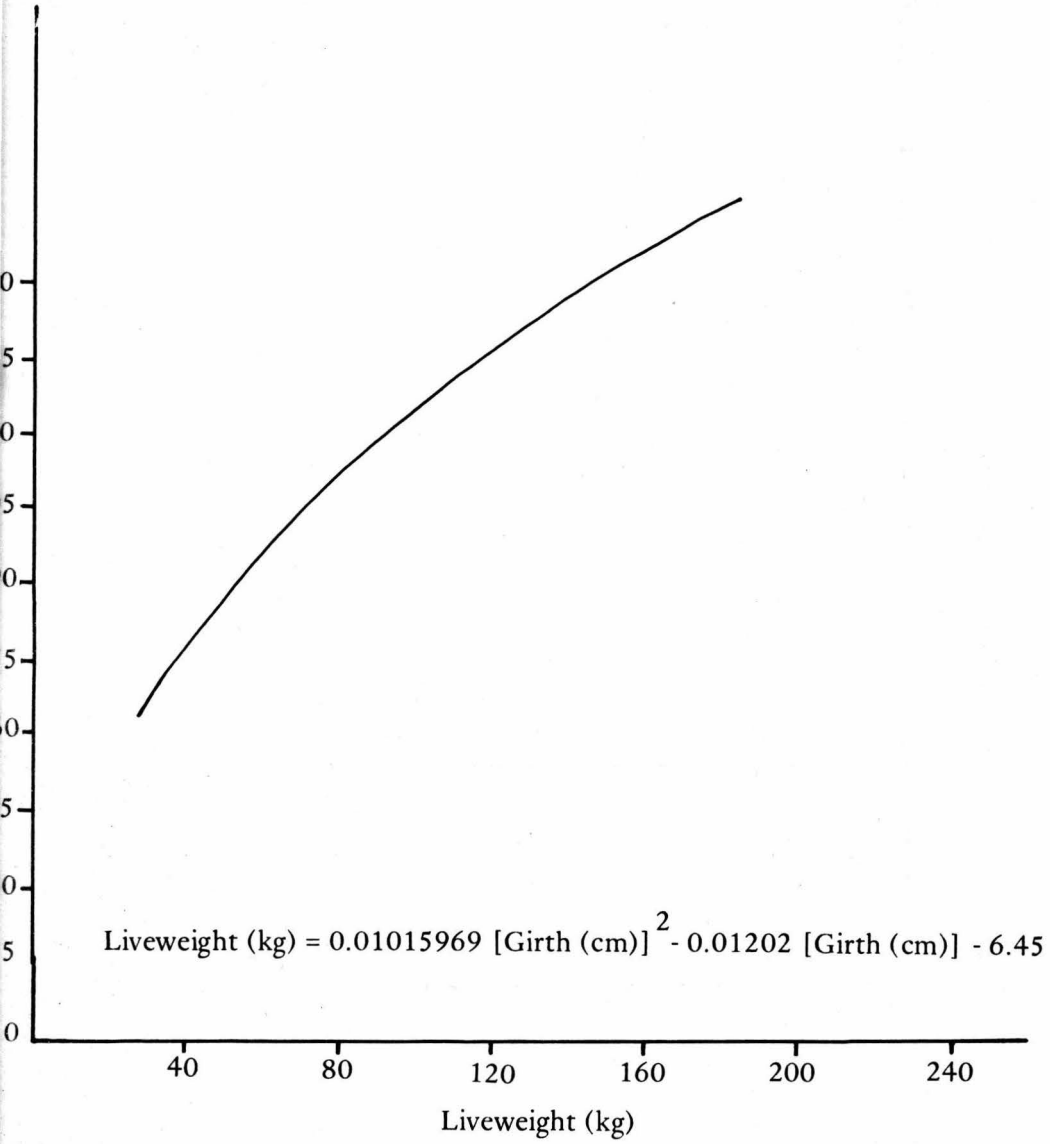


Figure 16. The relationship between girth circumference and weight of highland cows (Falvey et. al., 1977).

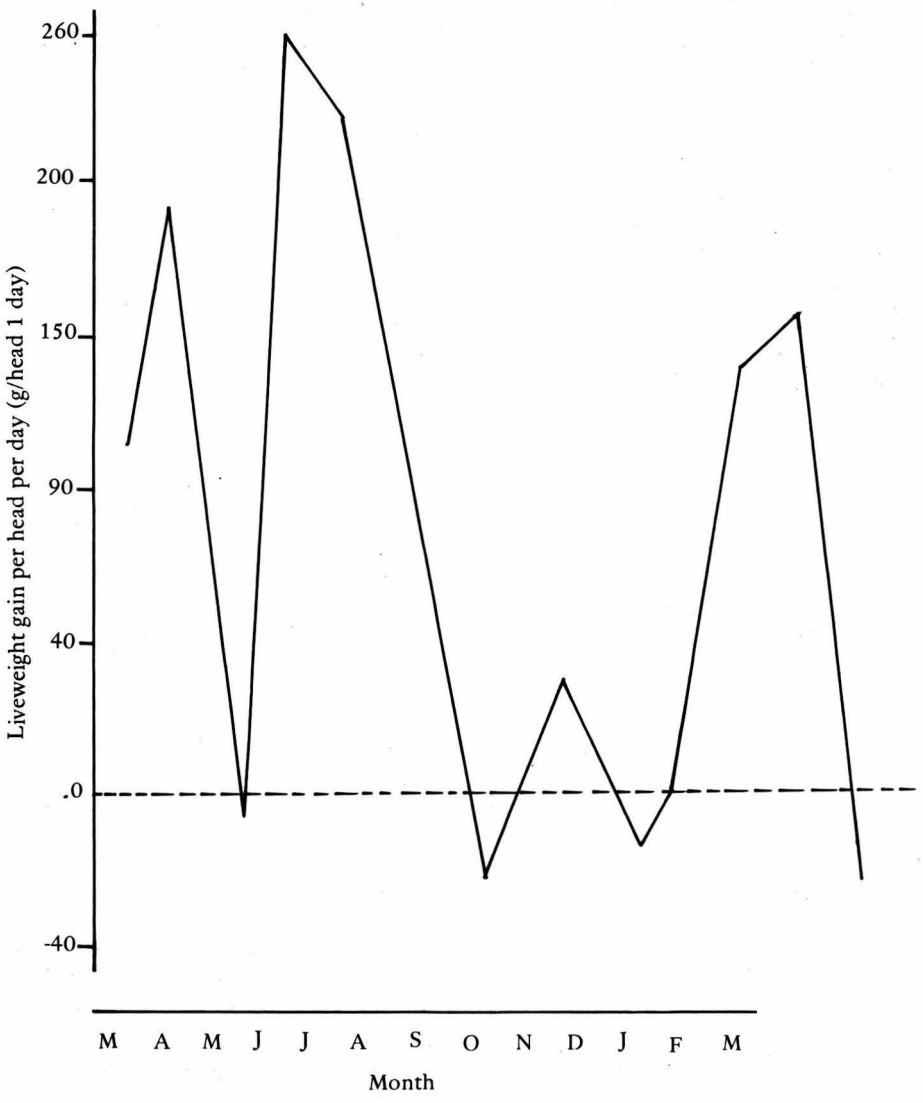


Figure 17. Liveweight changes of highland cattle grazing native pasture over a one year period (after Hoave et. al., 1977).

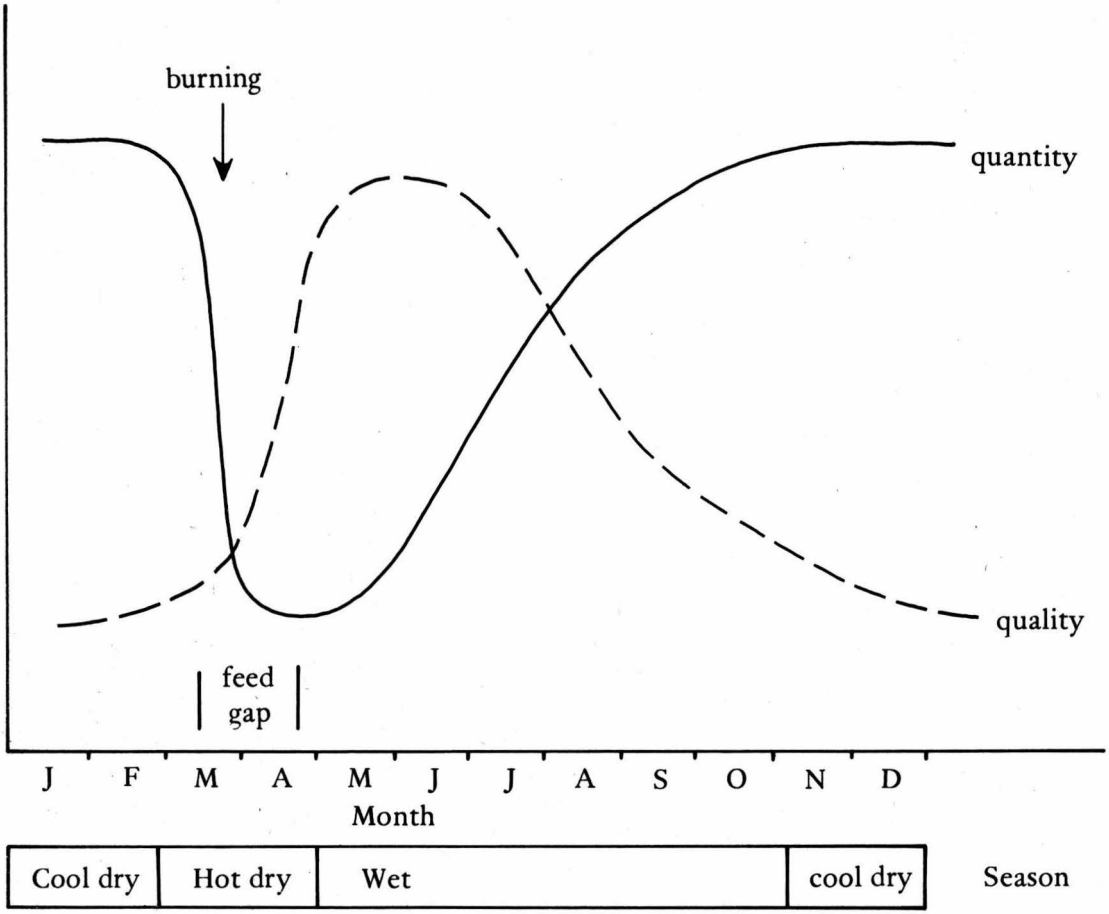


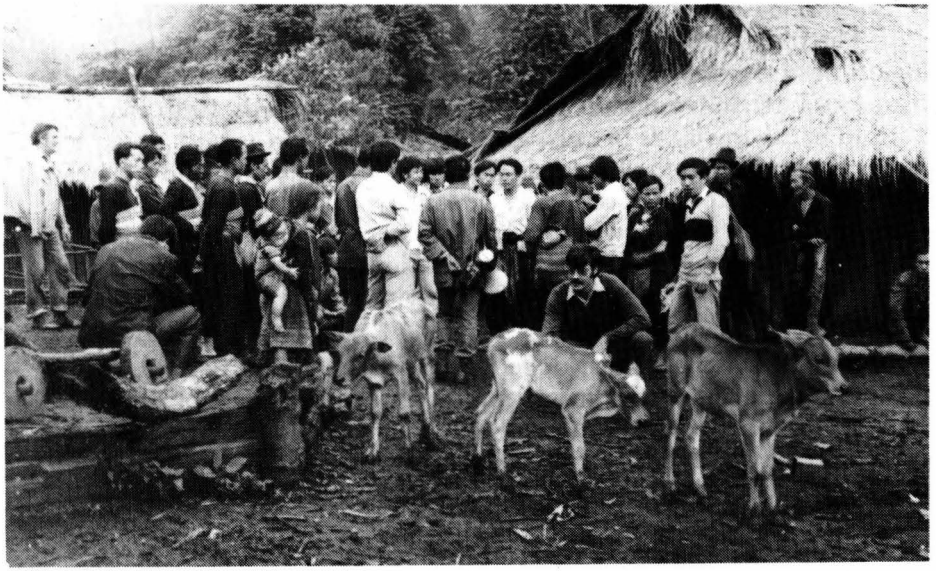
Figure 18. Schematic representation of natural pasture quality and quantity over afe year.

The grazing habits and patterns of cattle grazing native pastures in the highlands have also been investigated by HAP (Falvey et al., - 1978). In this study the activities of a group of highland cattle grazing native pastures were recorded every 45 minutes throughout the grazing day over a period of one year. The pattern of highland cattle in this study was of decreasing grazing intensity to a mean low at 1230 hours followed by a rise up to the last time of observation for the day, which probably indicates an adaptation to the practice of night yarding. The least time was spent grazing during the dry season,

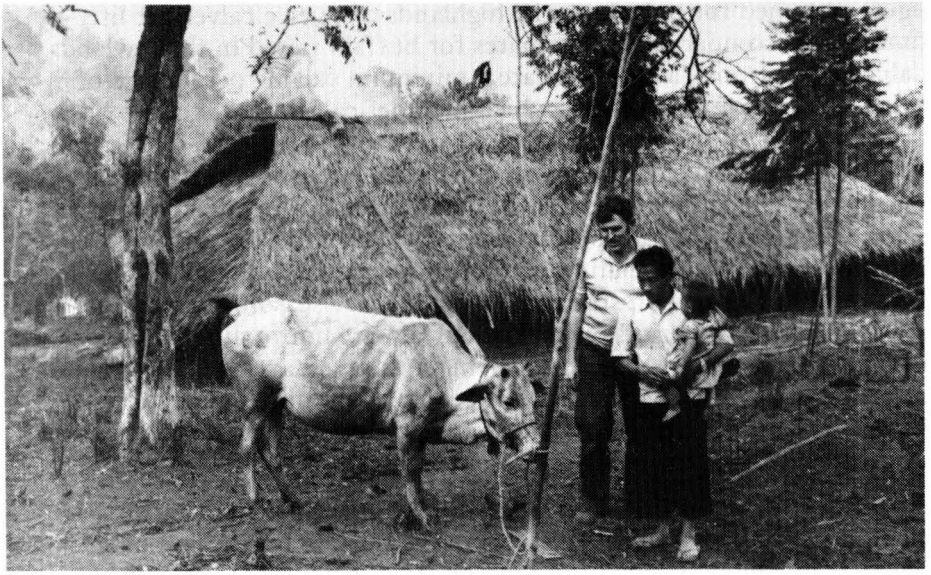
The incidence of resting varied inversely with that of grazing with a peak at 1230 hours. Resting while lying down was more common than resting while standing, and probably indicates a longer break from grazing. Resting while standing was predominant during the early morning and the late afternoon indicating shorter periods of resting. Much of the daytime resting time usually spent by cattle may have transferred to the night in this case, due to the highland practice of night yarding of cattle.

Ruminating similarly appeared to be transferred from daylight to nighttime in response the practice of night yarding. Ruminating in the late afternoon was restricted to the dry season, which in conjunction with decreased grazing time during this season may indicate a reduction in feed intake allowing rumination that would normally be practised of a night time to be moved forward to the late afternoon. Drinking by cattle also seemed to have adapted to the night-yarding system by being concentrated in the late afternoon. The preference of valley areas by cattle during the late afternoon and all day during the dry season indicates that it is the availability of these areas that will determine the potential stocking for a given area. An average stocking rate of 15 hectares per beast was calculted for this herd, however the actual stocking rate in valley areas may have been higher than one beast per hectare during the late dry season.

Investigations into the native species grazed by highland cattle indicate that Imperata cylindrica constitutes most of the diet with small amounts of other species such as Desmodium spp, Gmelia arborea (fruit), Cynodon dactylon, Paspalum spp, Digitaria spp, Saccharum spontaneum, Neyandia reynandiana, Thysalaena maxima, wild banana (Musa spp) and Bamboo.



Inspection of native cattle in a Meo village as part of a field day for local farmers. The calves are less than three months of age.



A pregnant highland cow in a Meo village. The cattle usually camp on the bare ground between the houses during the night.

Buffalo

The ranges and means of replies to questions related to the biological performance of buffalo are presented in Table 10. The performance of buffalo would not be expected to vary greatly from that of buffalo in the lowlands because they are of the same genetic pool. Buffaloes are bought in the lowlands and taken into the highlands. Thus any variation that does occur may be largely a function of the environment. While some lowland cattle are taken into the highlands and crossbreeding occurs freely in these situations, the type of cattle that has evolved in the highlands is sufficiently different from the lowland types to be easily recognized.

Buffalo heifers require longer to reach sexual maturity than cattle and under average conditions exhibit a calving interval of about 18 months. Some owners thought that their buffalo produced one calf per year, which may be possible for two years under good conditions but is most unlikely in the long term. Cockrill (1974) has noted that buffalo in the lowlands of Thailand reach sexual maturity at about 4 years of age, produce about one calf every two years up to 18 years of age and live up to 25 years, which is all in agreement with the data of Table 10 for buffalo in the highlands. Extrapolation from Cockrill's data gives a figure of more than ten calves per cow-lifetime. Rufener (1971), working with buffalo in the north-east of Thailand, estimated that buffalo produce ten to fifteen calves per lifetime. The figure obtained for buffalo in the highlands of twelve calves per lifetime is thus comparable to estimates for buffalo raised in the lowlands. Calculations from Table 8 indicate a minimum calving percentage of 51 for buffalo on a herd basis which includes calf deaths.

Most births seemed to occur during the late wet season which means that conception must usually take place during the cool dry season. Rufener (1971) could not provide definitive data on calving time for buffalo under natural conditions because, as he noted, lowland buffalo are often restrained during the rice season, thereby restricting mating to periods when the buffalo are not required for work. Cockrill (1974) notes that peak calving occurs, on average, 2.2 months after the peak rainfall incidence. A generalized rainfall histogram using a four year average from data at the Pa Kia field site and the period of greatest calving incidence is presented as figure 19.

Abortions in buffalo are much more frequent than in cattle, particularly for the first calf. The working of buffalo during late pregnancy is one likely contributing factor. Cockrill (1974) has also noted that abortion in buffalo heifers is a general occurrence.

The length of heat in both cattle and buffaloes was said to average about 2.5 days. This question was asked of villagers to ascertain their observational ability of factors concerning livestock. The narrow range of replies indicate that most owners were skilled at observing such factors. There were, however, some owners who had no idea low long heat lasted and could not answer the question.

Table 10. Biological data for buffalo. Ranges and means from information obtained in surveys.

Biological Parameter	Range of replies	Mean of replies
Age of heifer at first calving (Years)	3 - 7	4.4
Months between calves	12 - 24	18.5
Month of peak births	Aug. to Feb.	Oct. to Dec.
Length of life (years)	15 - 40	25.6
Calves per cow per lifetime	7 - 20	12
Years to reach full size	4 - 8	6.3
Length of heat (days)	2 - 3	2.5

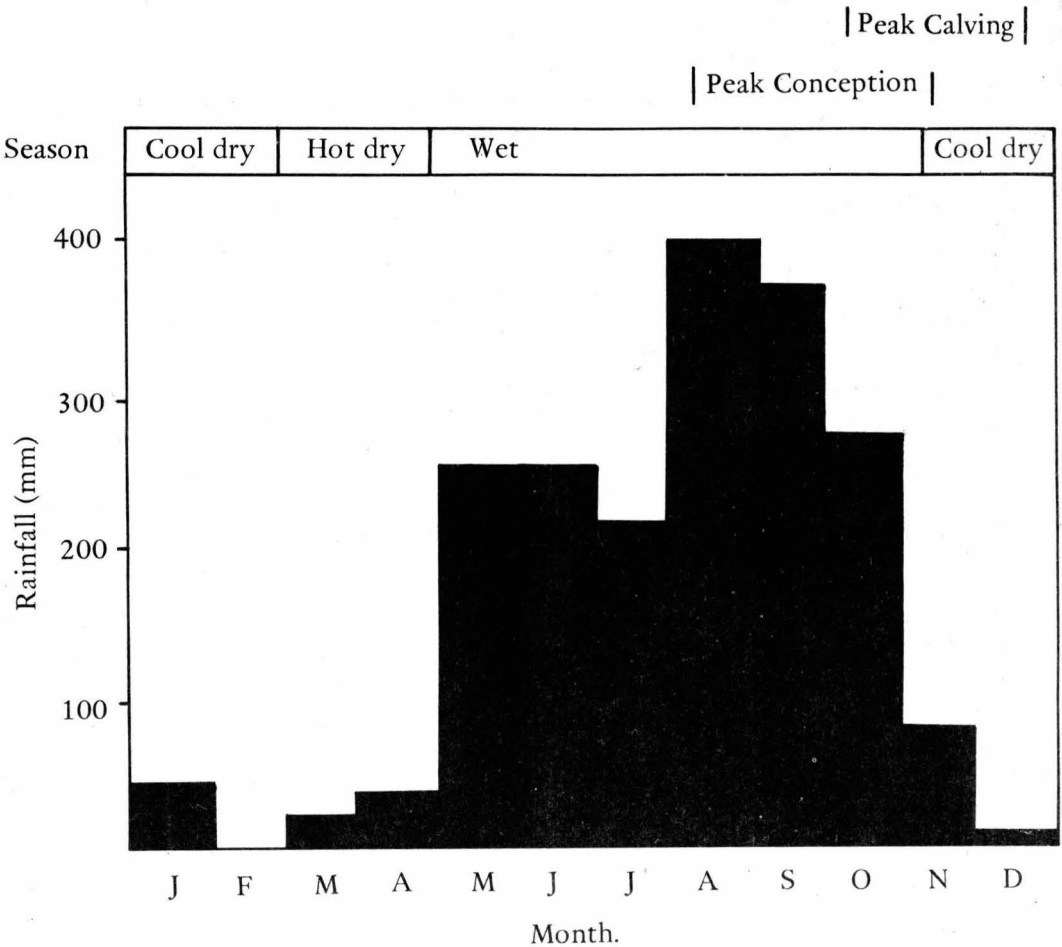


Figure 19. Rainfall distribution, seasonal and reproductive patterns of buffaloes in the highlands.

A highland cow and newborn calf at a Meo village. During the first few days after birth the cow may not leave the village and thus have little to eat.

Weighing the calf (at age about four days) with the assistance of Meo villagers.

ECONOMIC ASPECTS OF THE HIGHLAND CATTLE AND BUFFALO INDUSTRIES

Sales and purchases

Income derived from agistment

Income from leasing of working stock

Pack animals

The relative efficiency of cattle and buffalo

ECONOMIC ASPECTS OF THE HIGHLAND CATTLE AND BUFFALO INDUSTRIES

Income can be derived from cattle and buffalo in the highlands by sales, agistment, leasing and by using animals as beasts of burden. The industry is largely based on the need for security or the need to be able to fulfil sacrificial obligations; thus the income derived is less than would be expected from other systems, even when the work performed by stock for their owners is costed. The value placed on security or the need to follow traditional religious patterns could thus be said to be the cost between the income possible from a herd of the same size raised to produce income, and the actual income derived. In one village surveyed with a total herd number of say 225 head, an income of 80,000 baht per annum could be obtained from conservative calculations; however, income from sales was, in fact neglible. This averages 2,700 baht per household, an appreciable potential addition to the income of highland people. As noted previously poor management of cattle and buffalo largely reflects the purposes for which they are kept, and change of emphasis from traditional to commercial raising would probably show an increase in management inputs.

Sales and Purchases

Cattle and buffalo sale transactions are usually restricted to the locality because stock must be walked from place to place. Buyers usually come to villages to buy cattle except when a villager finds himself in urgent need of money. In that case he may take his stock to other areas, usually in the lowlands, for sale. Highland people are mostly reluctant to take stock down to the lowlands for sale because if the price offered is low, the inconvenience of taking stock back to the village and the urgent need for cash means that the price may have to be accepted. Similarly, the purchaser will usually offer a low price. Even if the price offered is the same as that paid by buyers who come seeking cattle in the village, the price must be discounted by the costs incurred in going away from the village. Some highlanders who have moved to lower altitudes to cultivate paddy rice have embraced the lowland marketing system of auctions and can use it to their own advantage. At the Lahu village of Ban Ja Phuu, buffalo are not bred at all as only male buffalo are purchased for paddy cultivation and drawing carts. Buffalo aged about five years are bought at the local lowland sales and worked for about five years. They are sold through the same system for a slight profit. Cockrill (1974), noted the same phenomenum among lowland Thai people and suggested that the period for which buffalo are kept may be becoming shorter.

In villages close to large markets, regular visits by lowland traders have created a reasonably stable marketing system. At the Meo village of Ban Nong Hoi cattle merchants from Chiang Mai visit to buy groups of cattle. These cattle are in same cases untended and wild, which is said to reduce the price.

The reasons for sale of stock give an indication of the attitudes of the different ethnic groups and the degree of contact they have had with lowland ideas. Some Meo and Yao villages have sold cattle after problems with stock breaking into cropping areas were encountered, because in some cases this cost the stock owner the value of the damage to the crop and in all cases caused him some embarrasment. In Khon Muang villages, the desire for attractive houses and other material possession leads to the sale of livestock, while in a Christian Lahu village an instance of some cattle being sold to provide money to send children to a school away from the village was recorded.

An annual cycle of sales and purchases was apparent in some villages where sales were forced by rice shortages in the late dry and wet seasons. After the wet season harvest, income derived from opium or other crops was then invested in more stock. Thus stock are used as a bank account. Prices offered at a time when more stock are available for sales may be lower than prices when demand is high, although no price disparity was observed in this study. Persons from the lowlands seeking to buy cattle usually restrict their purchases to the dry season both because of the problem of access during the wet season and the availability of stock for sale. In the Yao village of Ban Law Sii Kuay, the sale of young buffalo is necessitated during most dry seasons. Older animals are kept because they are already trained to work paddy fields and the villagers hope that they can reach the situation where they do not have to sell stock every dry season.

Transactions within a village may take place at lower prices, particularly in Karen and Lisu villages. Wongsprasert (1975) noted some details of an interesting transaction within a Lahu village. The two parties involved could not reach agreement alone thus a Khon Muang trader entered the transaction by buying the beast from the first Lahu man then reselling it a few days later to the second Lahu for the same price. Wongsprasert suggests that this may illustrate a mutual distrust of the Lahu in dealing directly with each other, although, as he notes, other transactions for example opium, are taken on trust and purity of the opium is not checked when it changes hands within Lahu villages as it is for transactions outside the village. In some internal transactions, bartering seems acceptable although uncommon.

Lowland Thai people in many cases buy buffalo to work paddy fields at the start of the rice season and then sell them when the season has finished. This creates a situation of varying prices, with purchase prices for the lowland farmer being higher than selling prices. Nevertheless, this is considered to be quite acceptable because the difference in the price is usually less than the cost of renting a buffalo for the season. Highland villages in reasonably close proximity to lowland rice paddies may become part of this system and thereby benefit, not only from the price variation but through the natural increase of the buffalo also. The time of buffalo sales by lowland. Thais coincides with a period when highland people may still have capital reserve and thus they can enter this system and capitalize on it, both through the price variation and natural increase. The frequency of highland people involved in this business is, however, low.

The income generated from stock was not usually a significant part of the total income except in the cases of some large stock owners. However, Hinton (1975) noted that sales of livestock including pigs and poultry can be the largest single income producing item in a Karen village. In one study, in the Mae Saleap region, amphoe Mae Chan, income from the sales of cattle during a one year period for villages was estimated to be between 800-9400 baht for villages raising cattle (จันทยูรณสุทธิ, 1976)

Stock sold to the lowlands are used for draft and meat purposes. Highland cattle are on average smaller of stature than lowland cattle or cattle entering Thailand from Burma, thus they are less popular for draft purposes. Those stock destined for the meat market include both male and female stock, and they are mainly slaughtered illegally. The "Propagation and Conservation of Livestock and Beasts of Burden B.E. 2492 (1949)" states that all cattle and buffalo shipped to slaughter houses must meet at least one of the following requirements:

Being eight to ten years old,
If female, being over fifteen years of age,
Being lame or crippled,
Being over five years old and sterile,
Producing poor quality calves,
Having inherited a contagious disease,
In special cases, for religious purposes.

The ease of circumventing these regulations has lead to a large proportion of the meat sold in Thailand coming from animals that have been slaughtered illegally.

The prices of transactions involving cattle in twelve years are presented in Table 11. Similar information for buffalo is presented in Table 12. Prices were calculated to a kilogram base for cattle by using the growth curve for highland cattle (figure 15). In the case of buffalo, growth rates were determined from other HAP work.

Table 11. Average Price per Kilogram received for Highland Cattle in Villages in different Years

Year	Number of transactions	Average price per kilogram liveweight (baht)
1957	1	1.6
1960	1	2.3
1964	1	5.5
1966	2	3.4
1968	7	5.9
1970	7	4.1
1971	3	3.9
1972	5	5.7
1973	10	4.3
1974	11	6.0
1975	42	7.5
1976	23	7.9

Table 12. Average Prices per Kilogram received for Buffalo in Villages in different years.

Year	Number of transactions	Average price per kilogram (baht)
1956	1	1.1
1961	1	1.8
1962	1	2.2
1966	1	2.6
1970	1	2.6
1971	9	5.2
1973	6	4.3
1974	3	5.5
1975	11	7.5
1976	6	8.2

The prices for buffalo transactions were more variable than those for cattle transactions. This is probably related to the reasons for buying buffalo; a buffalo trained to work and of good conformation can attract a significantly better price than an untrained beast of poorer conformation at the same weight.

Prices paid in the highlands are lower than those commonly quoted by developmental agencies, which indicates that the price paid in Chiang Mai cannot be applied generally across the highlands. Transactions in the more remote areas tended to be at lower prices, presumably because the demand was lower due to the problems and costs of moving animals to market areas. Mean prices for cattle sold in Chiang Mai over the period January-April 1976 varied from approximately 4500 baht for a large animal to approximately 2400 baht for a small animal. For buffaloes the range was about 4350 baht to 2400 baht. These prices are much higher than those received in the highlands for highland cattle on a per head basis but are closer on a per kilogram basis, due to the larger size of lowland cattle. Nevertheless a difference in price of at least 25% between transactions in Chiang Mai and transactions in the highlands seems to be the rule.

Sex of cattle and buffalo did not seem to affect price to the same extent as whether an animal was suitable for working. In many cases, of course, male cattle were considered to be of greater value because they are stronger and thus better suited for working purposes. On the other hand, pregnant cows or cows with calves at foot attracted good prices also.

The variation of prices for both cattle and buffalo over several years are presented graphically in figure 20. The trends in prices are upward as would as would be expected. Over the last twenty years price of both cattle and buffalo have risen by approximately 450% that is, an average of 23% increase per year. In the case of cattle a line of best fit can be drawn that indicates a steady rise in price over the whole period. For buffalo however the rise seems to have largely restricted to the last six years. The rise in price from the 14 years, 1956 to 1970 was only 136% compared to 216% for the six year period 1970 to 1976. This may reflect some increasing demand for buffalo in the lowland regions close to the highland regions over the last six years. Various sources (eg. มาลีกุล, 1977) have noted that the number of cattle and buffalo raised in Thailand is probably decreasing and in fact numbers would be at a very low level if stock were not illegally brought into Thailand from Burma regularly. The effects of shortage may have acted to increase prices over a long period but do not explain the apparent

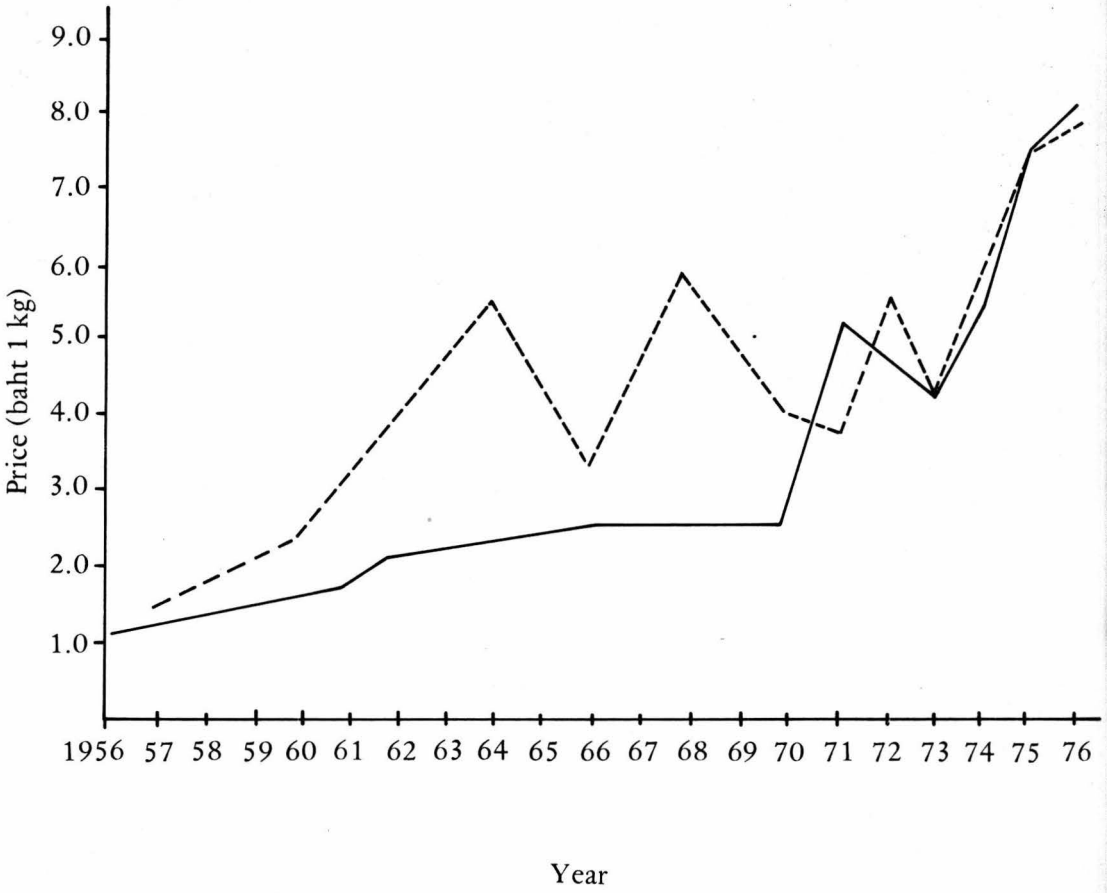


Figure 20. Variations in the price of cattle and buffalo ever several years (.....cattle, _____buffalo).

One tang of unhusked rice is equivalent to approimately 10 kg.

disparity in price rises between cattle and buffalo. One possible explantion is, that on lowland areas, buffalo are generally considered to be more useful than cattle and greater price elasticity is shown in response to increased demand. The value of cattle as draft animals is less than that of buffalo in most areas of lowland Thailand because of the buffaloes' superiority for ploughing flooded paddy fields. Mechanical cultivation of paddy fields, while quite common in many regions of Thailand, is seldom seen in paddy fields adjacent to the highland areas. Increased use of small mechanical cultivation implements would decrease the demand for buffalo and so reduce the price differential with cattle to a certain extent. If, on the other hand, demand continued to increase, the use of cattle in place of buffalo may occur to a greater extent than it does at present; in the Sukhothai area of Thailand cattle are used in preference to buffalo to cultivate paddy fields.

Income derived from Agistment

Agistment is the tending of stock belonging to someone else for a fee. It is practised in highland villages to varying extents. Usually the owners of the stock placed in highland villages on agistment are lowland dwellers who do not have sufficient area to run many cattle. In exceptional cases cattle may be agisted by highland people. For example, in the Yao village of Ban Pha Deua in a lower altitude area of the highlands, cattle were sent to another village on agistment due to a shortage of grazing land near the village of their owners.

Villages included in these surveys where cattle or buffalo were involved in agistment were:

Ban Ton Kham, Pang Mae Ta Man Nok, Pang Mae Ta Man Nai, Ban Huai Tat, Ban Mae Mae, Ban (New) Pa Kia, Ban Mae Pun Luang, Ban Doi Yao, Ban Huai Hin Fon, Ban Pong Khrai, Ban Pong Lung. This represents about 27% of the villages visited, which makes this enterprise of potential economic importance to highland people.

The most common arrangement between the stock owner and the person who looks after the stock, is that the stock tender receives every second calf as a fee. The stock involved are almost invariably females. Contracts between the two parties vary from those that do not encourage the tender to care for the animal to any great extent to those which place a great responsibility on the tender to look after the stock. For example in the case of buffalo sent on agistment from the Yao village of Doi Yao, care of stock was encouraged by a strict contractual agreement. The buffalo tender was to pay the owner the value of any animals that died through lack of care, disease

or were lost through theft. Also included in this contract was an unusual economic arrangement whereby calves were to be distributed on the usual fifty-fifty basis over the contractual period, but a cash adjustment based on the value of the calves at the time of their birth was made to ensure that both tender and owner received half of the summed value. The agistment arrangement of the Yao village of Ban Pha Deua is simply equal division of income derived from sales of progeny with the decision as to when a sale takes place resting largely with the tender.

Of the 42 villages visited to compile this report, only one had entered the cattle raising business solely through earning calves as agistment fees. This was the Khon muang village of Ban Pang Lung. In other cases cattle were bought as well and the calves earned as agistment fees added to the herd. In the case of poorer individuals in some villages, for example, the Khon muang village of Ban Ton Kham most calves earned as agistment fees were sold to the owner of the cow within a year of birth.

In many cases, accepting stock on agistment can be regarded as sign of initiative. Often the household that received stock on agistment already owned cattle and wanted to increase their herd size more quickly. Instances of highland people going to the lowlands and canvassing for stock to be placed in their villages on agistment were recorded.

Agistment of stock in the highlands is a logical means of utilizing natural resources more efficiently. In the lowlands buffalo are used to cultivate paddy fields during the rice planting season but remain a liability for the remainder of the year because they must be fed in an area that does not contain much pasture. Thus they are fed rice stubble and straw supplemented by what green material the stock can find themselves. At the onset of the wet season the heaviest work that must be performed by the animals coincided with the end of a long period of poor nutrition. Some improvement in nutrition is afforded by the first new growth of grass that occurs at the start of the wet season and, in some cases legume crop residue can be grazed. However it is likely that if the buffalo were tended in highland areas they might be in better condition for working at the start of the wet season, as well as producing more offspring. Such an arrangment could mutually benefit both lowland and highland people. From the point of view of the strength of the buffalo for working in the early wet season, leasing of buffalo from highland owners offers the same advantage.

Income from Leasing of Working Stock

The production of income from stock by leasing them to do work for other people concerns only buffalo in the highlands because buffalo are believed to be better suited to paddy rice cultivation than cattle. It is possible that short term arrangements for lease of working cattle, for example pulling a cart, are arranged, but no instances of such dealings were encountered.

Buffalo are raised in some Akha and Lahu villages for leasing to lowland rice growers during the dry season. Usually the person renting the buffalo is a lowland Thai person who does not own buffalo and cannot rent elsewhere. However, in one instance the Akha at Ban Sae Ja Mai rented buffalo from the neighbouring Akha village of Ban Saen Suk because there were not sufficient buffalo in their own village to cultivate their paddy fields.

Some details of buffalo leasing transactions are presented in Table 13. The choice as to whether the rental fee will be paid in cash or rice is usually made before the buffalo is taken although the conversion rate between the two is known to both parties. Under some circumstances a percentage of the rice harvest, say 15% may be settled on by both parties as a fair price. Large differences in the fees charged between different areas were recorded for example, the Akha people at Ban Pha Mii have received up to 150 tang of rice for a trained adult buffalo compared with a 15-30 tang in another area. The variation in prices within a village reflect individual negotiations as well as the quality of the animal in question. In the Akha village of Ban Saen Suk charges ranged from 15-20 tang of rice per season to 80 tang with a normal range of 50-60 tang. The two most important factors in this business are the proximity to paddy rice fields and the availability of working buffalo in the area. Other factors such as the relationship between the lessor and lessee are also of importance in some cases. Cockrill (1974) quotes lowland rentals at 200-1000 Kg rice per season.

Arrangements between the leasee and leasor vary from verbal agreements where the buffalo owner has little recourse in the event of accidents or foul play, to written contracts. At the Akha village of Ban Pha Mii, photographs of individual animals were used to determine rental prices. Such agreement was witnessed by an independent third person and in some instances a contract was prepared which the witness also had to sign. After rice harvest, the buffalo owner goes to obtain his stock and rice from the low-

TABLE 13

Buffalo leasing details

Village owning buffalo	Age of buffalo	Income derived (per rice season)
Mae Pun	Young	200 baht
Mae Pun Luang	Adult	500 baht
Mae Pun Luang	Adult	15-30 tang rice
Doi Yao	Young	20 tang rice
Doi Yao	Adult	50 tang rice
Pha Mii	Young	70-80 tang rice
Pha Mii	Adult	100-150 tang rice
Saen Suk	Adult	50-60 tang rice

One tang of unhusked rice is equivalent to approximately 10 kg.

lands. This arrangement may be a reflection of the Akha's distrust of visitors especially lowlanders who are suspected of bringing evil spirits into the village with them (Young, 1964). The progressive nature of Akha persons involve in this business does not support this explanation. In other instances, the rice rental fee is loaded onto the back of the buffalo and the animal led back to its owner in the highlands.

Pack Animals

In the highlands, cattle, horses and donkeys are employed to transport loads along narrow, winding, steep, walking-trails. In most cases, horses are the preferred species especially among the ethnic minority groups - the main residents of the true highlands. Miang growers, however usually use cattle to transport their product to the nearest road if the road does not reach their village. Keen (1972) notes that miang is transported by slinging one tang on each side of a pack cattle beasts which are led along mountain trails in a long cattle train.

Roy (1965) notes that a miang garden tenant often invests in oxen because they are readily available and saleable. At the time Roy wrote, a young bull could be bought for 500 baht, and after five years, be sold for twice that price while having earnt an income as a pack animal during the five years. Pack animals were said

to be able to earn about 350 baht per year. In the miang village of Pang Mae Ta Man Nai, the two households engaged in this enterprise charged 25 baht per 100 Kg transported to the nearest road served by regular motorized transport. Keen (1972) records freight rates to be about 25 baht per 1000 Kg. All figures reported to have been earned in this enterprise should be discounted by the income that the owner could have earned if he had worked in his village. Thus the number of animals owned and utilized in one train has a large bearing on the real profit derived from pack animals.

The role of cattle as pack animals is likely to decrease as road access to most areas is improved. There is however, the possibility that more bulky crops will replace opium as the main cash crop of the highlands which may require the use of pack animals over short distances to the nearest road.

In the lower altitudes of the highlands that are easily accessible to lowland areas, cattle and buffalo may be employed to pull carts following the lowland practise. One extreme example is the Lahu village of Ban Ja Phuu where all the buffalo owned are paired for pulling carts. This practise cannot be extended into the true highland areas because of the steep terrain.

The Relative Efficiency of Cattle and Buffalo

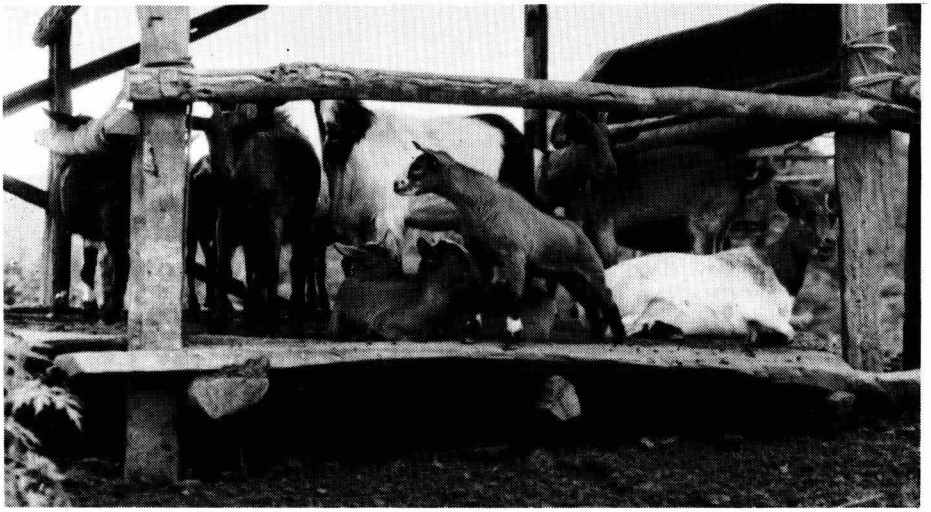
Using the data presented in tables 9 and 10 concerning the biological efficiency of cattle and buffalo and estimated growth rates of both cattle and buffalo from H.A.P. research, superior efficiency of buffalo on a per head basis is evident. Over a period of seven years, sufficient time for a buffalo to grow to mature size, the increase in biomass from one average cattle cow was about 1140 Kg compared with 1660 for an average buffalo cow. The efficiency of biomass production of cattle in these circumstances is only 67% of that of buffalo. The lower reproductive rate of buffalo is more than compensated for by the faster growth rate and larger mature weight of the buffalo. Even in the first year a simple calculation of reproductive efficiency multiplied by the expected weight of a one year old beast indicates similar average biomass production after one year. In subsequent years the buffalo shows a faster rate of increase than cattle. This result should not be confused with that of Rufener (1971) where the opposite trend was calculated. The cattle investigated by Rufener in the North East of Thailand were of larger conformation and showed faster growth rates. Sex dimorphism is more marked in

cattle than buffalo and may thus partially compensate for the difference in efficiencies if only male cattle are considered.

A comparison of average prices paid for cattle and buffalo from figure 18 indicates that, in most years the raising of buffalo has probably been more profitable than cattle. The prices for the year 1976 were higher per kilogram for buffalo than cattle which makes buffalo seem a much more profitable enterprise than cattle. Such comparisons ignore other differences about the two species, however. Some villagers insist that buffalo are more easily stolen and each buffalo beast stolen represents a larger financial loss to the owner than each cattle beast lost. This "negative thinking" approach to the problem must be considered in the light of the low expected income of highland people which means in some cases that they probably prefer to reduce financial risks where possible. The price they pay for the reduction in risk is the difference in expected profit from buffalo raising compared with cattle raising. In many cases, the risk of theft of buffalo is reckoned to be similar to that of cattle and the additional potential profit (whether transfered into cash by sale, hiring out, or use by the owner) is sufficient to warrant full time tending of the buffalo while they are grazing. Thus tending of buffalo while they are grazing is a much more common practice than the tending of cattle.

Buffalo raising in the highlands at present is restricted to regions close to lowland areas where they can be readily sold. Expansion of buffalo raising in the highlands may be possible although there are many regions such as drier areas to which cattle may be better suited.

Cattle are sometimes used for pack purposes in some areas of the highlands not serviced by roads. They are most commonly employed by miang growers.



Goats are raised in some highland villages. Coat colours are varied, and the mature size of goat in these usually inbred herds is small.

MOVEMENT OF LIVESTOCK INTO NORTHERN THAILAND

MOVEMENT OF LIVESTOCK INTO NORTHERN THAILAND

The number of cattle and buffalo raised in Thailand when compared to the number consumed indicates that some of the stock must come from neighbouring countries. The movement of stock from Burma into Thailand is well known and an established trade has been developed for many years.

The official means of bringing stock into Thailand involves, firstly contacting the amphoe office and supplying a description of the animal. The amphoe veterianarian must then be advised so that he can inspect the stock and vaccinate against the diseases, foot-and-mouth and haemorhagic septicaemia. Customs duty of 45 baht per head or 3% of the purchase price is then payable to allow the stock to enter Thailand. Stock can stay in the region for a period of two weeks while the amphoe representative contacts the Livestock Department for formal permission to move the stock into Thailand. Previous unfortunate experiences when the system has failed has encouraged the development of an illegal trade which handles most of the stock traffic into Thailand.

It is claimed that in the event of a disease outbreak among stock in Burma (in particular, rinderpest), the Thai government will be notified and no imports of stock will be allowed. Such an agreement would only apply to legal movements of cattle and in any case would depend on the efficiency of the Burmese government. Some disease control is, however, practised by persons involved in the illegal cattle and buffalo importing business in amphoe Mae Sod. Animals that are obviously sick, the symptoms of foot-and-mouth disease and haemorhagic septicaemia being known to those involved in the trade, are not brought into Thailand. Cattle, if held for any period of time, are kept on the Burmese side of the border and thus any sick animals are left in Burma rather than Thailand. Such a practice has probably evolved to protect the investment of the purchaser.

Many people recognize that if there was no such illegal trade, there would not be enough cattle and buffalo for meat, draft and in some cases, export in Thailand. On the other hand, such a view may promote a general apathy toward future development of Thailand's livestock industries toward self-sufficiency. Recently the Burmese government has decided to act to curb this outflow of livestock from Burma because shortages of draft animals are now apparent. Whether their decision has a lasting effect on the cattle traffic remains to be seen.

The main area of cattle imports into Thailand is Mae Sod. The villages are primarily Karen who are at present warring with the Burmese although Thai, Chinese and Indian people also live in the villages. They have settled on both sides of the border between Thailand and Burma, marked in this area by the Moey River. The situation of their villages on either side of the river assists the movement of cattle into Thailand during periods when there is no fighting. In one village in this area, stock are moved across at an estimated average rate of about 80 head per day. This figure varies up to 400 head per day when the prices for cattle and buffalo are higher and weather conditions are suitable for movement of cattle. Another neighbouring village in the Mae Sod area is probably the principal site of cattle and buffalo movement into Thailand. An estimated average of 300 head per day come from Burma during the dry season period. Up to 1000 head were said to have arrived on some days. Sheep and goats are also brought across the border at these places but the profit received is considerably less and thus the total value of sheep and goats brought into Thailand is relatively small compared with that of cattle and buffalo.

Cattle entering Thailand in the vicinity of Mae Sot are originally purchased by Karen persons in Burma who may have to travel 10 days to one month in order to obtain suitable cattle or buffalo. Each person involved buys only a small number of stock so that travel is quicker and it is easier to avoid Burmese soldiers. In incidents where Burmese soldiers have been encountered the new owner usually is able to escape but the cattle are kept for food by the soldiers. Calves born while cattle are being moved through the Burmese highlands are killed to avoid slowing the progress of other animals, and occassionally some stock purchased do die during the walk to Thailand through highland regions. Cattle are formed into a large herds on the Burmese side of the border and if the price offered in Thailand is not acceptable they are held in Burma. A tax of ten baht per head is changed by the Karen for the cattle leaving Burma and a tax of 45 baht is, in theory, payable to the Thai customs for cattle entering Thailand. Buyers come to inspect large herds of cattle on the Thai side of the border and purchases are made on an individual animal basis. Any calves born after cows arrive at the border are given away with their mothers when they are sold. Cattle are purchased at prices ranging from 800 to 3000 baht for cattle and 1500 to 5000 baht for buffalo. If cattle stay in the area for any length of time they should be registered with the amphoe office, thus most stock are transported out of the province soon after arrival. Stock are trucked to markets in Sukhothai, Lampang, Chiang

Mai and Bangkok. Sukhothai is a large market for draft cattle and in some cases stock are taken to the Sukhothai area to fatten before they are resold. Buffalo for draft purposes are mainly sold in Lampang province while both cattle and buffalo for meat are sold in both Chiang Mai and Bangkok. During the rice season draft-buffalo may be sold in Chiang Mai. The profits accrued in this business were said to be about 20% for the Karen selling to the Indian, Chinese and Thai merchants who in turn make about 30 to 40% on their investment. These figures compare with an estimated 19% profit on capital invested for the merchant moving stock within Thailand as suggested by Ashfaq (1975).

The second main area of stock movement into Thailand involving Shan, Kachin, Tung Su, Lahu and Chinese Haw people is the border areas of amphoe Fang, north of Chiang Mai. An estimated number of 1000 head of cattle and buffalo were said to enter Thailand at Doi Luang, Doi Mae Na and Doi Mae Sao. A charge of about 50 baht per head for stock entering Thailand is payable to Chinese nationalist soldiers or to the other police stationed in the border region. If cattle entered by the legal route an additional 35 to 55 baht must be paid for customs duty and registration of stock. In two other villages involved in this trade, an estimated number of 2000 head of cattle and buffalo in 1975, 1000 head in 1976 and probably less for the present year 1977, have entered Thailand. Large herds of up to 300 cattle may cross the border in one herd. Persons from these villages may not have to pay a fee to the troops stationed in the area if they move in a large group and are on friendly terms with the local troops. Cattle are said to be purchased for as little as 400 baht although the average price may be closer to 800 baht, and are resold in Thailand for more than 1000 baht. Stock entering Thailand by this route are walked along similar paths to those used by opium traders because, although the same persons may not be involved in both trades, there is apparently a certain safety in numbers against thieves and other dangers. Stock entering via amphoe Fang reach the lowlands near amphoe Chiang Dao where they are sold mainly to traders from Chiang Mai for both draft work and meat.

In the vicinity of Mae Sariang, cattle and buffalo enter Thailand through Karen and Shan villages. The border between Thailand and Burma at this point is the Salween River and stock are swum across using long-tail boats to guide them. Stock are bought in different areas of Burma by residents of the border villages and enter Thailand in herds of about 40 head at an average interval of two to three weeks

to give a total number of about 1000 head per year. At one village an estimated 70% of the stock entering Thailand are buffalo that have, in some cases, been said to come across Burma from Bangladesh. At Mae Hong Sorn, cattle and buffalo also enter Thailand from Burma via Shan villages with the involvement of the Shan Union Army and the Chinese nationalist army.

In Chiang Rai province many stock enter from Burma at both Akha and Lahu villages. Persons from these villages enter Burma and return with cattle and buffalo which they tend for a short period before resale to lowland traders. Up to 100 cattle are moved across the border at one time in these activities. At one Akha village in amphoe Mae Sai a cattle and buffalo importing business used to be operated whereby 20-30 head were brought into Thailand at one time. Now the centre of this activity has shifted south-west to a Lahu village in amphoe Mae Chan.

Some of the principal routes for cattle and buffalo movement into northern Thailand are marked on figure 21. Only the main routes are shown and the volume of traffic along each route is not indicated because it is determined by both economic and political conditions. Cattle and buffalo can enter Thailand at many more points than those indicated on the diagram and stock may eventually find their way to the Bangkok market.

A total number of more than 10,000 cattle and buffalo are probably entering northern Thailand each year. While the number must vary greatly, the well developed infrastructure for this illegal trade allows it to act quickly in response to economic demands.

The movement of cattle and buffalo into Thailand from Burma in response to the better markets of Thailand has its corollary in the movement of stock across the Thailand-Malaysia border in response to an even better market (มาลีกุล, 1977).

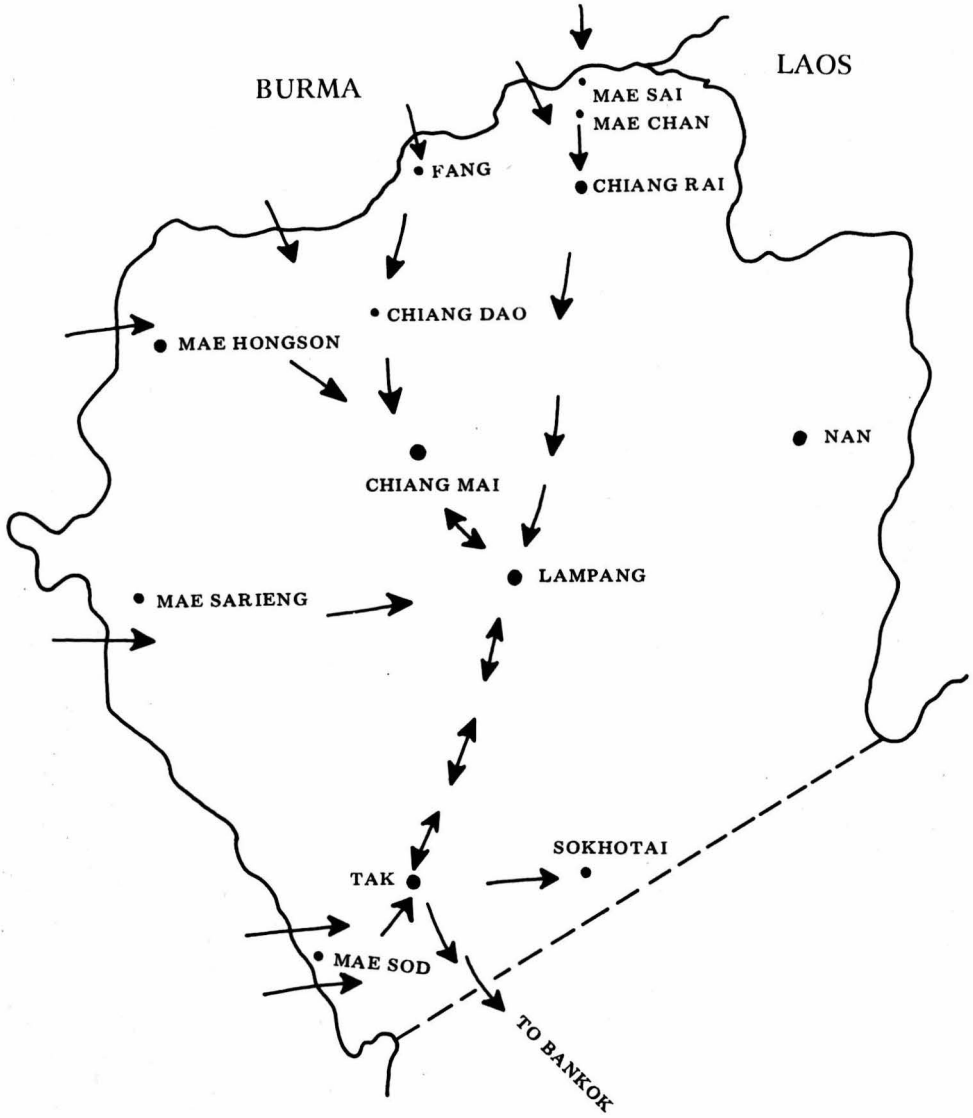


Figure 21. Routes by which cattle and buffalo enter Thailand and the most common routes of travel in Thailand.

THE INTEGRATION OF RUMINANTS AND AGRICUTURAL SYSTEMS IN THE HIGHLANDS

THE INTEGRATION OF RUMINANT AND AGRICULTURAL SYSTEMS IN THE HIGHLANDS

Although the prime reason for tending cattle or buffalo in the highlands is not always economic, stock raising is sometimes combined with other agricultural activities from convenience. Some situations where livestock can be integrated with other agricultural activities are: the grazing of stock under or amongst some crops, the utilization of stock to consume crop residues, the utilization of manure as organic fertilizer for crops, and of course, the use of stock to prepare fields and transport agricultural products. In situations where some integration between stock and crops is practised, the expected benefit to the crops is usually the primary consideration.

Some industries where stock can graze under or amongst crops are miang, tea, coffee, fruit trees, tobacco and forestry. Keen (1972) has already noted that the pack cattle used to transport miang from villages to the nearest road graze among the tea trees when they are not working. The open nature of miang gardens after the removal of the forest appears to enhance growth of the native grasses. "The animals help to keep the land clear as well as supporting themselves, and they are permitted to roam freely on any person's land." Cattle do not like to eat the leaves of the tea bushes and apparently do not cause any appreciable damage to the trees. In the case of tea production rather than miang, the pruned nature of the bushes tends to render them more suseptible to damage from cattle and buffalo. Stock apparently rub against the bushes and can dislodge bushes in some circumstances. Fencing of tea plantations is practised to keep cattle from entering and damaging the tea bushes. Buffalo are usually credited with being more careful when grazing, particularly on rice terraces but in the tea plantation their rubbing and wallowing habits make them unacceptable. There is however a possibility that cattle can graze amongst tea stands once they are greater than five years of age on areas of lower slope, without causing great damage to the tea.

Cattle or buffalo may possibly be able to graze under coffee bushes after the coffee is older than tree years. The principal problem seems to be the breaking of lower branches when stock brush past them. In the early years of establishing coffee stock must be fenced out. During this stage it has been suggested that the pasture legume greenleaf desmodium (Desmodium intortum) can be grown among the coffee for seed production because the production of greenleaf desmodium seed can earn an income during the years be-

fore the coffee begins to bear heavily (Hoare, 1976). Greenleaf desmodium would still provide a good quality pasture under the coffee bushes after the crop was no longer maintained for seed production. Even in situations where no understorey crop was sown, native grass growth may provide some grazing in the years after coffee bushes were well established and before shading from the coffee trees restricted grass growth. Where coffee is grown under a dense shade canopy, understorey grass growth is often minimal.

Grazing of cattle and buffalo under fruit trees is practised, often unconciously in some of the small plantations of the native peach trees that are sometimes sown into abandoned swiddens by some highland dwellers. The experimental planting of many species of fruit trees new to the highlands may extend the area where these two enterprises can be integrated. The damage caused by cattle or buffalo in orchards should be minimal for the most of the year in established orchards. In the flowering and fruit production season however, the action of stock rubbing on trees may significantly reduce the final fruit yield through causing flowers and fruit to drop. The lower leaves of some fruit trees are sometimes grazed by stock although this does not usually occur to a noticable extent unless alternative feed becomes limiting.

Cattle can graze amongst tobacco plants to a limited extent. Trained animals that graze more carefully have been observed to be tied up close to tobacco fields so that they can graze the understorey vegetation, tobacco leaves apparently being unpalatable. As tobacco is planted primarily in the lowlands, this activity does have wide application in the highlands.

The replanting of grassland areas to trees, in particular Pinus species is taking large areas of grasslands that were once grazing areas for village cattle and buffalo. Stock are usually prohibited from entering the reafforested areas because they are believed to cause a great deal of damage to young trees. The method of replanting trees into native grassland and the four by four metre planting spacing leaves available a large amount of grazing, except for a small area around each tree. The damage to young tree seedlings that cattle and buffalo can cause is well recognized but also easily over-emphasized. After trees have attained a reasonable height and are growing steadily stock may be able to graze amongst the trees with minimal damage for several years until the tree canopy closes and the reduced sunlight input causes a decrease in understorey productivity eventually reducing the understorey growth to neglible proportions. Irwin (1977) states that "a total grazing period of five to six years is probably a

reasonable working assumption". In some replanted areas, stock are at present grazing amongst trees illegally. A large proportion of the damage attributed to cattle and buffalo grazing in reafforested areas is said to be caused by persons tending the cattle. There is wide scope for greater integration of the grazing and reafforestation industries. In the Lisu village, Ban La Pa Ta, Forestry Department personnel assist in cattle tending to prevent cattle entering newly reafforested area, and have promised that the cattle may enter these areas after the trees are five years old. Such cooperation has encouraged the Lisu to respect the reafforestation programme which is an important factor in its success that was not encountered elsewhere in the highlands.

The role of cattle in the social and agricultural systems of highland dwellers must be considered wherever forest is replanted. It has been argued that the reafforestation activities do not take away grazing land from villagers to the extent claimed because replanting of trees into areas dominated by the unpalatable weeds of the Eupatorium species. This is generally untrue, as Imperata dominated areas are much more commonly used in the replanting programme. As these grassland areas result from the swiddening activity of highland people they are usually close to villages and are therefore used as grazing lands.

A section from a recent report by a forester working in the highlands presents some of the views of persons concerned with reafforestation per se. "The main damage done is to young plantations of forest trees where counts have shown locally up to 75 percent of the seedlings destroyed or damaged by browsing or trampling. These young plantations are an attractive source of grazing especially in the wet season, for during the dry season fallow paddy fields provide a good deal of the grazing needed. The villagers state that they need grazing areas, and that if all the potential grazing areas are made into forest plantations they have no alternative but to graze their cattle in the plantations. There is some truth in this, but it is not the whole truth, for abandoned swiddens are normally occupied by a dense growth of Eupatorium during which there is little good grazing, whereas in forest plantations where this is kept in check the grazing is much better" (Jackson, 1977).

While this attitude recognizes the need of villagers for grazing land it may be misleading in suggesting that highland cattle generally have access to paddy fields during the dry season. Usually highland cattle must walk long distances to find good grazing during the dry sea-

son because paddy fields can only be found at the lower attitudes of the highlands whereas during the wet season sufficient grazing can usually be found close to the village. Similarly, the repopulation of abandoned swiddens by Eupatorium species is not the typical situation except in Karen swiddens. Nevertheless, it is acknowledged that the reafforestation programmes can be orientated to include livestock to a certain extent, for example "One solution would be to leave part of the area unplanted until the trees in the rest of the area were three or four years old and relatively immune to grazing damage (though pines nearly three metre high are sometimes bent over by buffaloes). Then the plantations would be open to grazing, and the remaining areas planted up. A more permanent solution would be the creation of improved pastures, and such measures as the introduction of fodder crops as ground cover in orchards or possibly as part of the farming cycle on rain fed terraces" (Jackson, 1977).

Whether cattle as part of the highland economy should be accommodated in the reafforestation campaigns or whether forestry should be accommodated in the highland economy is a question that cannot be debated here. It is, however, necessary to point out that potential income of the areas lost by the highland people will, in all probability, not be made up directly to the highland people.

Stock are utilized to help clear up rice stubble in paddy fields in the lowlands and to a minor extent in the highlands. Other crop residues in the highlands such as highland rice and corn are eaten by stock in some situations and the scope for development of the field seems large with the promotion of legume crops. The residue of such crops may be a real benefit to both the stock as well as the stock assisting to clear up the area for the next crop. A further use of livestock mentioned by Snook (quoted in Mather, 1977) is to clear up firebreaks by sowing a palatable annual legume such as Townsville stylo which can be grazed off completely in the dry season to provide a good firebreak as well as providing good nutrition for the stock. Unfortunately the practicalities of this suggestion preclude its implementation. Cattle would probably have to graze in the forests all year which is usually offensive to foresters, the higher palatability of dry Townsville stylo compared to that of regrowing blady grass in closed areas that are sure to be burned is also doubtful, and the adaptability of Townsville stylo to the highlands is also in question.

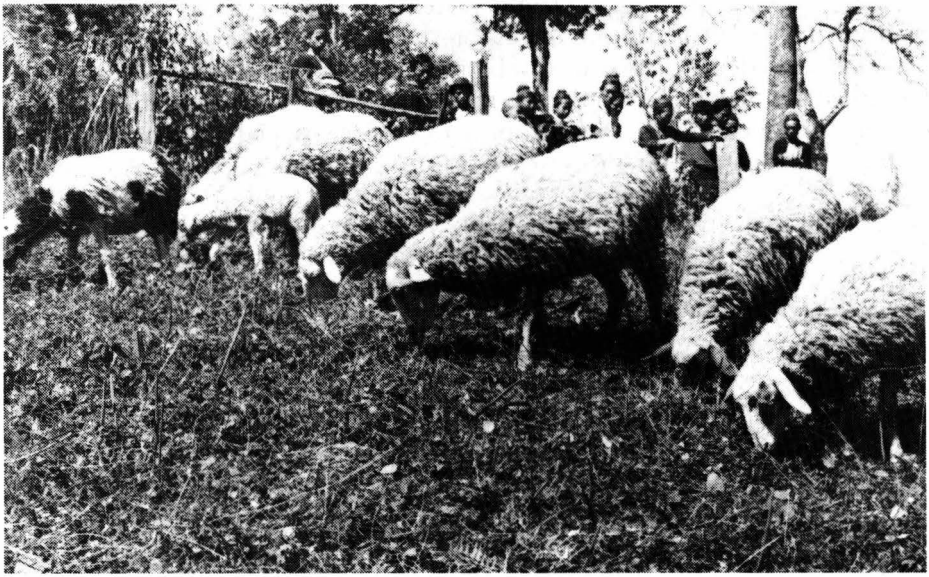
Utilization of cattle and buffalo manure as fertilizer for crops is practised by a few individuals. The main use is in home vegetable gar-

dens which are usually more common around Christian villages. The distance between the village, where the cattle usually spend each night, and cultivation fields may be up to one days walk which acts to discourage the wider use of cattle and buffalo manure. The ease of colection of manure from the night camp area of the stock facilitates the extension of this practice. As land for shifting cultivation becomes more limiting in the highlands, more stable agricultural systems must be implemented which will probably be much closer to the village. Thus cattle and buffalo faeces could be more widely utilized. The fertilizer quality of this manure could be improved by increasing the legume content of the diet of the stock and by any fertilizer applied to the previous crop.

Employing stock in the preparation of cropping fields is another practice largely associated with the lowlands. Whether stock can be utilized in a similar way in the highlands in a stable agricultural system has yet to be determined. The transport of agricultural produce using stock is also limited in the highlands. The main product transported by pack animals is miang although same grain crops have been transported at different times. The use of carts drawn by cattle or buffalo is restricted to the lowlands and lower altitudes of the highlands.

The small ruminants, goats and sheep, may also be integrated into existing or proposed agricultural systems in the highlands. The problems of managing goats and of raising sheep may render integration a little more difficult than it would be for the large ruminants. Goats require strict management to curb their wide dietary tastes and heavy grazing tendencies while sheep appear to require special attention to prevent their succumbing to disease.

Buffalo, 50% Native X 50% Brahman heifers and a 75% Brahman bull grazing a mixture of grass species.



Sheep of two breeds grazing improved legume pasture (Desmodium intortum) at Pa Kia.

OTHER RUMINANTS OF THE HIGHLANDS

OTHER RUMINANTS OF THE HIGHLANDS

This study would not be complete without some discussion of the other grazing ruminants present in the highlands, namely goats and sheep.

Information concerning small ruminants in the highlands has been compiled in the Proceedings of a seminar held at Chiang Mai University in 1976. The follow summary is largely drawn from some of the papers presented at that seminar.

Keen (1972) has noted that "goats are slowly increasing in popularity in the poppy villages of North Thailand. As a recent innovation they are not hedged about with ritual and taboo like the traditionally ordered pigs and chickens, so are used for food in a rational manner according to need. They fend for themselves unrestricted on the native pastures and generally maintain good health. As yet (1972) they are not in large enough numbers to form a major threat to the natural vegetation". Goats have now been noted to be a controversial animal in the highlands as they are in many other areas of the world. Comparisons of the relative biological and economic efficiency of goats and sheep are rare but extrapolation from the only information available indicates that goats are markedly superior. Such comparison however, does not consider the relative ease of handling or relative damage caused to the environment.

Goats in the highlands of Thailand show similarities to the goats of south China, Malaysia, and Bangladesh. Does produce their first kid at an age of 12-18 month, and kid twice per year producing twins on many occasions. Physical maturity requires three to four years. The main problems encountered in goat raising are; damage to the environment, diseases. (to a similar extent to cattle with a greater suseptibility to screw worm or warble infestation), and to a very minor extent, predators.

Adult goats are usually sold to buyers, primarily Muslims who come to the villages. The high reproductive rate, hardy nature and low investment required to enter goat raising, makes it a feasible alternative to cattle raising, although it is somewhat less prestigious and markets could be easily over supplied.

An approximate growth curve for highland goats is presented as figure 22. This level of productivity is sub-maximal but may be regarded as satisfactory; and performance is probably limited by inbreeding and, perhaps poor nutrition.

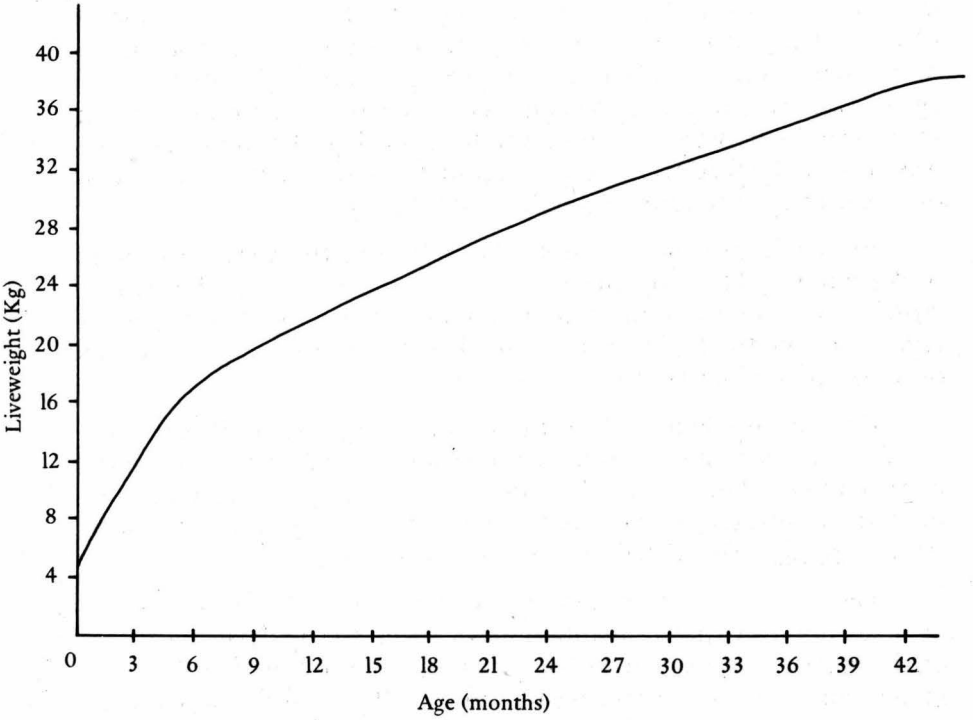


Figure 22 The approximate growth curve for goats in the highlands (after Falvey, 1977)

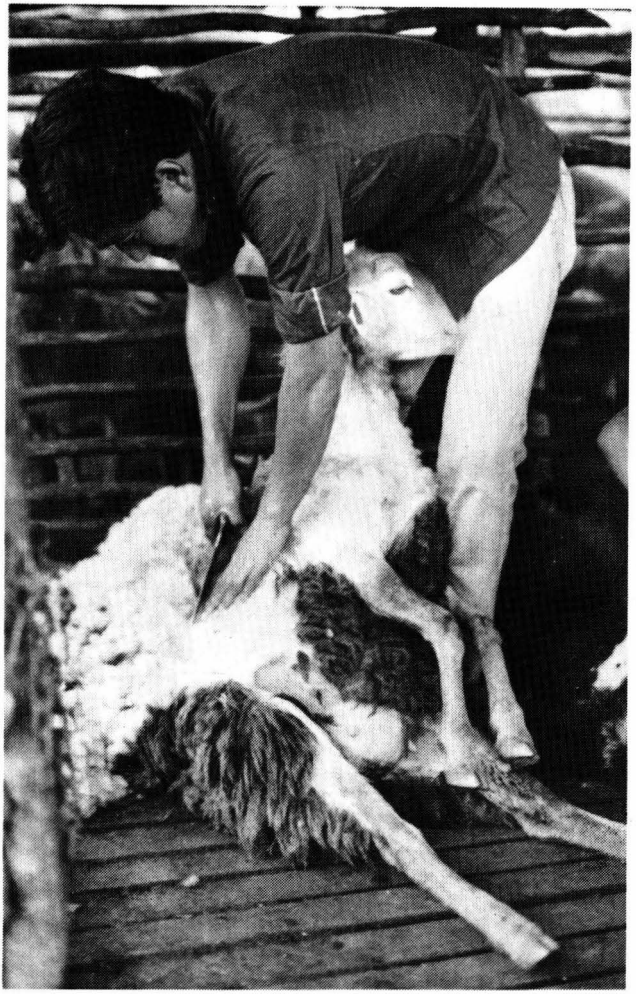
Ownership of goats was not found to be obviously related to any parameters used to estimate wealth, possibly because of the low capital cost of an individual animal. Management is low although goat pens for night yarding were observed in some Meo, Lahu and Akha villages. Castration soon after birth is widely practised because of both the undesirability of too many billy goats and the demand of the market (Falvey, 1977).

Survey of highland villages where sheep are tended and experimental work by H.A.P. at Pa Kia indicate that sheep may not be readily adapted to the conditions of mininal management practised in the highlands. In all but one case, sheep had been donated by some agency assisting highland development. A larger degree of variation in liveweight between sheep of similar ages than that between goats was recorded. Birthweights were around 2.0 kilogram and weight at one year of age varied between 9.5 and 27.5 Kg.

Fleece length and quality also reflected the variable genetic backgrounds. The only fleece of any quality seemed to be that of crossbreeds between indigenous and imported breeds. A high percentage of many flocks inspected had died from internal parasites and other complications (Falvey, 1976).

Evaluation conducted by the Highland Agronomy Project indicated crossbreeding can produced a hardier animal of great potential market value. The role of clean dry night housing for sheep has also been demonstrated as well as the importance of internal parasites (Hoare, et; al., 1976; Falvey and Reitschel, 1977)

The future role of both sheep and goats in the highlands depends not only on the adaptability of sheep to the environment or the means of management for goat raising but on market demand. Sheep and goats (for meat) and goats (for milk) are bought primarily by Muslim traders for sale within their own community. This market would be easily saturated and unless a wider cross-section of the Thai community change their dietary preferences the industry must remain small. The sale of wool from sheep is also very limited unless the quality improves markedly.



Shearing a 50% German Merino X 50% Thai Indigenous sheep at Pa Kia. This fleece has some potential economic value while the fleece of 100% Thai indigenous sheep has virtually none.

THE FUTURE FOR RUMINANTS IN THE HIGHLANDS

THE FUTURE FOR RUMINANT INDUSTRIES IN THE HIGHLANDS

The additional income available to highland people through small changes in the existing livestock systems is considered the primarily justification for interest in the development of the ruminant industries. Regular sales and improved management could provide an increase in economic efficiency of larger proportions than many other agricultural products. The danger of increased stock numbers to the watershed characteristics of the highlands is considered to be minimal under moderate management inputs. In fact, present village herd sizes may well be reduced in some cases to encourage greater efficiency.

At present the highland ruminant industries are not entirely economically orientated both in the commercial sense and with regard to economic use of the resource by the village. Development of the ruminant industries is usually based on economics rather than improvement of the industry to serve the existing reason for keeping stock. To overcome traditional practices and encourage regular sales to produce a regular income and avoid overstocking the grasslands while protecting the investment of the people, incentives to change and participate in the market economy must be offered to the people. Such incentives must come largely from market prices. Some changes are already evident; for example, sacrifices of large ruminants are being partly replaced by pigs and poultry.

The present production of livestock of the highlands can be improved in many fields. Nevertheless, existing systems have evolved over a very long time and must be respected for the adaptation to the environment which is evident in highland cattle. A complete change of the system would most probably be unacceptable to highland dwellers and might in any case be less feasible. Differences in attitudes between the various ethnic groups represented in the highlands must be considered when any changes are proposed. General differences such as the aversion of the Meo to work for others, and the Karen's desire to accumulate possessions including large livestock while still outwardly appearing to be poor must be acknowledged. Specific differences exist within ethnic groups; for example, the Meo at Ban Nong Hoi wish to sell all their cattle while the Meo at New Pa Kia wish to increase their herd size.

Development of a grazing industry in the highlands can be approached from many aspects; however, the overall impact of many small improvements at the same time may interact to give a greater effect than the imposition of improvements individually.

One means of utilizing the highlands more efficiently for grazing is to replace some of the native Imperata with species better suited to grazing. Considerable research has revealed that this may be feasible in some circumstances (Gibson, 1976). An alternative means of increasing the nutrition of stock is through the use of supplements (Mikled, 1977). In both situations, the stocking rate that can be supported must be based on the worst period of the year, the feed gap Thus increasing stock numbers or recommending high stocking rates for improved pastures must be approached with care.

Other improvements possible such as animal health, grazing management, breeding and selection, and general husbandry could also be imposed simultaneously. A reliable network of trained paraveterinarians to work in the highlands has been suggested as the most realistic means of improving health of highland stock (Ashfaq, 1976). Improvements in the herding of stock during grazing could assist cattle to obtain diets of reasonable quality while protecting the rangeland from weed invasion or overgrazing. Greater herding inputs should also reduce the risk of stock losses to thieves and predators.

Selection of bulls within the native herd should yield benefits in the uniformity of offspring. Size could also be increased if the largest bulls are not castrated. The infusion of exotic blood, probably Brahman, could be used to increase the mature size of highland cattle and perhaps increase their marketability as draft animals. The suitability of highland cattle to their environment should however, be retained to the greatest extent possible; thus infusions of exotic blood to levels greater than 50% are not recommended. The inherent sex dimorphism of highland cattle exemplified in the much larger body size of males compared with females should not be discarded as it suits the market available admirably with the larger males being sold for draft and meat and the smaller cows with their lower maintenance requirements used simply for breeding purposes. Sale of surplus females, males and cows culled for low productivity or old age could also be practised. The rather late age of heifers at first calving, is probably acceptable and earlier calving should not be selected for unless nutrition has first been increased substantially.

More careful observation of individual animals which could be facilitated by the erection of corrals could allow villagers to detect sick animals at an early stage and treat them or seek advice accordingly. Provision of night yards with roofing, adequate space and wind breaks and location on well drained sites should decrease the incidence

of calf mortality by reducing the incidence of intestinal parasites and white scours. An adaptation period for cattle imported from lowland areas when special attention and perhaps a supplement are offered is recommended. Deaths of newborn calves in the cool season are not uncommon and could possibly be avoided by extra care on the part of the owner, to ensure that the young calf is kept warm while still able to suckle at will.

The use of training courses to explain some basic improved techniques that can be implemented by cattle owners themselves and an effective follow up service by extension workers is also an important means of initiating development of the industry.

The economic future for ruminant industries in the highlands appears sound with a steady demand for meat and for draft animals. The draft animals market may decrease in the lowland areas of the northern provinces as small tractors replace buffalo in paddy field cultivation. Nevetheless, the demand for meat will increase as the as the population increases. The possibility of dairying in the highlands has been raised but is not considered to be a practical suggestion at this stage, due to the constraints of management and transport. The quality of nutrition could possibly be raised to a level greater than that possible in the lowlands and cooler climate should favour dairy breeds, if the problems of access to markets and management could be overcome. The marketability of milk products would also need to be increased.

The demand for land in the highlands of northern Thailand is great, not by highland dwellers alone but also by Government Departments for planting of pine trees, coffee and other crops. A politically acceptable proposal for livestock development may therefore be one based on increased efficiency of the existing industry rather than an expansion in scale.

REFERENCES

REFERENCES

Ashfaq.,M. (1975) Promotion of livestock production in the highlands of northern Thailand.
Ministry of Agriculture and Cooperatives, Northern Region Agricultural Development Centre, Chiang Mai, Thailand (mimeo).

Ashfaq, M. (1976) Planning livestock industry in northern Thailand
Ministry of Agriculture and Cooperatives, Northern Region Agricultural Development Centre, Chiang Mai, Thailand (mimeo).

Coates, D.A. (1974) Reports on beef cattle production potential at Doi Sam Muen
Report to the United Nations Program for Drug Abuse Control, Crop Replacement Project, Chiang Mai, Thailand (mimeo).

Cockrill, W.R. (1974) The husbandry and health of the domestic buffalo. Published by FAO, Rome 1974.

Davies, R.F.J. and Toewiwat, N. (1976) Modelling changes in the pastures of the highlands of northern Thailand.
Northern Regional Agricultural Development Centre, Chiang Mai, Thailand (mimeo).

Falvey, L. (1976a) Sheep surveys in northern Thailand.
Proceedings of the First Meeting on small ruminants in the north Thailand highlands, held at the Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand, in September 1976.

Falvey, L. (1976b) Ruminant livestock survey of the Mae Ta Man catchment area by the Highland Agronomy Project.
Thai Australian Highland Agronomy Project, Chiang Mai University, Chiang Mai, Thailand (mimeo).

Falvey, L. (1977a) Review of existing knowledge of ruminants in the highlands of northern Thailand.
Thai Journal of Agricultural Science 10:111-119

Falvey, L. (1977b) Goats in the highlands of north Thailand
Thai Journal of Agricultural Science 10:121-130

Falvey, L., Mikled, C. and Thanyalappitak, E. (1977) Parasitological Investigations.
Second Report of the Highland Agronomy Project to Chiang Mai University and the Department of Public Welfare of the Kingdom of Thailand from the Australian Development Assistance Bureau, Canberra, Australia.

Falvey, L., Davies, R.F.S., Thanyalappitak, E and Mikled, C (1977) Relationships between weight, girth, height and age of the highland cattle of northern Thailand.
Thai Journal of Agricultural Science (in press)

Falvey, L.; Thanyalappitak, E. and Hengmichai, P (1978) Studies on the grazing behaviour of highland cattle
Thai Journal of Agriculture Science (in press).

Falvey, L and Rietschel, W (1977) The effect of internal parasites in sheep raised in the highlands of north Thailand.
Third Report of the Highland Agronomy Project to Chiang Mai University and the Department Public welfare of the Kingdom of Thailand from the Australian Development Assistance Bureau, Canbera, Australian.

Gibson, T. (1976) Report to the Department of Public Welfare and Chiang Mai University of the Kingdom of Thailand on pasture agronomy research carried at Pa Kia in 1972-75
Australian Development Assistance Agency, Canberra, Australia.

Hafez, E.S.E. and Bouissou, M.F. (1975) The behaviour of cattle. Chapter 10 in the behaviour of domestic animals edited by Hafez, E.S.E., 3rd edition, Bailliere Tindall.

Hinton, P. (1975) Karen subsistence : the limits of a swidden economy in northern Thailand.
Thesis submitted to Department of Anthropology, University of Sydney Australia.

Hoare, P (1976) Greenleaf seed production, Highland Agronomy Project Pilot Development Plans No. 2
Seminar of the Thai Australian Highland Agronomy Project held at Pa Kia, Thailand in December 1976.

Hoare, P., Mikled, C. and Thanyalappitak, E. (1976) Progress report on sheep at Pa Kia.
Proceedings of the first meeting on small ruminants in the north Thailand highlands, held at the Faculty of Agriculture, Chiang Mai University, Chiang Mai, Thailand, in September 1976.

Hoare, P., Mikled, C and Thanyalappitak, E (1977) Animal productivity of ruminants on rangeland grazing in the Pa Kia environment.
Second Report of the Highland Agronomy Project to Chiang Mai University and the Department of Public Welfare of the Kingdom of Thailand from the Australian Development Assistance Agency, Canberra, Australia.

Hoare, P. and Thanyalappitak, E (1977) The Pa Kia Village Cattle Fund.
Second report of the Highland Agronomy Project to Chiang Mai University and the Department of Public Welfare of the Kingdom of Thailand from Australian Development Assistance Agency, Canberra, Australia.

Irwin, R. (1977) Replacing shifting agriculture through settled agriculture, crop diversification and conservation farming.
Working paper of UNDP/FAO Mae Sa Integrated Watershed and Forest Land Use Project, Chiang Mai, Thailand.

Jackson, K. (1977) Working paper of UNDP/FAO Mae Sa Integrated Watershed and Forest Land Use Project, Chiang Mai, Thailand.

Keen, F.G.B. (1972) Upland tenure and land use in northern Thailand Published by S.E.A.T.O. Cultural Program 1969-1970.

Milkled, C (1977) Dry season supplementation of highland cattle.
Thai Journal of Agricultural Science 10 : 140-143.

Roth, A (1974) Final report of economic survey of eight U.N.P.D.A.C. project villages
United Nations Program for Drug Abuse Control, Chiang Mai, Thailand.

Roy, E.V. (1965) Structure of the miang economy in Ethnographic notes on northern Thailand, Data paper No. 28
S.E. Asia Program, Department of Asian Studies, Cornell University, Ithaca, New York, U.S.A., Edited Hank, L.M.,Hanks, J.R.and Sharp,L.

Rufener, N.H. (1971) Cattle and water buffalo production in villages of north eastern Thailand
PhD Thesis, University of Illinois, Urbana, Illinois, U.S.A.

Snook, L.C. (1975) Mae Sa Integrated watershed and forest land use project, Chiang Mai, Thailand - The establishment of productive pastures in the forests areas of northern Thailand FAO/UNDP report (mimeo).

Walker, A.R. (1970) Lahu Nyi (Red Lahu) village society and economy in northern Thailand.
Prepublication draft of terminal report to the Royal Thai Government.

Walker, A.R. (1975) Farmers in the hills : Upland peoples of north Thailand.
Penerbit Universiti Sains Malaysia.

Wongsprasert, S (1975a) How to approach the Meo in Mae Sa river catchment.
Tribal Research Centre, Department of Public Welfare, Chiang Mai, Thailand (mimeo).

Wongsprasert, S. (1975b) Lahu trade and commerce
Journal of the Siam Society 63(2) : 119-219

Wongsprasert, S (1977) The sociological and ecological determinants of Lahu population structure.
Tribal Research Centre, Department of Public Welfare, Chiang Mai, Thailand (mimeo)

Young, G. (1974) The hilltribes of northern Thailand.
Monograph No. 1 5th edition, the Siam Society, Bangkok.

จันทรบูรณ์สุทธิ (1976) รายงานการสำรวจภาวะการเศรษฐกิจและสังคมของชาวเขาเผ่าอีก้อ
โครงการแม่แสลป บริเวณลุ่มแม่น้ำแสลป ต.ป่าซาง อ.แม่จัน จังหวัดเชียงราย
ศูนย์วิจัยชาวเขากรมประชาสงเคราะห์ กระทรวงมหาดไทย

สุจินต์ ชลายคุปต์ (1977) การเลี้ยงโคกระบือ
Seminar on development of livestock through cooperatives, held at Chulongkorn University, Bangkok, Thailand, in February 1977.

มิตร มาลีกุล (1977) โคกระบือในประเทศไทยจะหมดลง
Seminar on development of livestock through cooperative movement, held at Chulongkorn University, Bangkok, Thailand, in February 1977.

Printed by Tippanetr Press 124-126 Tippanetr Shopping Center
Chiang Mai, Thailand Tel. 235088, 235675